

June 6, 2005

TO: D. Morris
FROM: A. Andujo/E. Hampton/J. Retana
SUBJECT: 2005 DSS-16 Closure Impact Study

The Resource Allocation Team has completed a special study to analyze the ability of the DSN to provide support to the current users of the DSS-16 antenna.

Background

In an effort to reduce cost throughout the DSN, JPL and IND management are considering retiring the 26 Meter antenna network. We have been tasked to analyze the impact of this closure to other DSN resources as well as the users of the DSN, specifically spacecraft limited to S-Band communications. This study focuses on the closure of the DSS-16 antenna and the upgrade of the DSS-27 antenna from November 21, 2005 through December 31, 2006.

Summary of Results

A review of supports currently scheduled at DSS-16 in the mid-range schedule weeks 47 through 52 of 2005 was conducted and it has been found that currently scheduled activities can be supported at DSS-24 or DSS-27 with an increase to capabilities at DSS-27. An analysis case has been developed where all DSS-16 supports are moved to other antennas at Goldstone, primarily DSS-24 and 27 and in some cases DSS-46 and 66. It has been found that the increase in contention during this period is at a workable level, meaning, the additional supports absorbed by other antennas due to the DSS-16 decommissioning can be negotiated without impacting non-26 Meter subnet users due to their priority status.

For the 2006 period, the forecast without DSS-16 is for an increase to contentions for 26 Meter subnet users will result in unsupportable time particularly during maintenance days. Canberra antennas, namely DSS-46 should see an increase to requested time through the end of 2006 due in part to a predominant Southern hemisphere viewperiod for POLAR and IMAGE. The Cluster mission requirement for 3 - 4 antenna arrays will primarily affect the SOHO mission with additional lost time due to the reduced number of antennas. Currently SOHO already uses the view at DSS-27 during a Cluster array.

Assumptions

- DSS – 16 closed November 21, 2005 (After DSS-15 Return to Service)
- DSS – 46 will remain operational throughout this period
- DSS – 66 will remain operational throughout this period
- DSS – 27 upgraded with full TT&C (NSP, SLE) with Acquisition Aid and Auto Tracking
- DSS – 27 Setup and Teardown time is unchanged for this study, but may increase due to the change in capability and their use.

Supports displaced as a result of the DSS-16 antenna decommissioning are mostly S-Band missions belonging to the SSMO mission set and are mostly reallocated to a resource with S-Band capability such as DSS-27 and the 34BWG1 Subnet and in a few cases DSS-46 and 66 causing additional contention.

Analysis

Analysis was accomplished using the JPL Tracking Integrated Ground Resource Allocation System (TIGRAS) scheduling tool, the updated mission set database from the February 2005 Resource Allocation Review Board (RARB), and currently developed schedules from the DSN Mid-Range process.

Negotiations for part of the study period under consideration are still in progress within the Mid-range process.

During analysis several factors were considered:

- DSN resources down during the requested time period
- DSN provides emergency support that may preempt or interrupt supports scheduled for network users

Individual Missions have experienced mixed results but for the most part the closure of DSS-16 is tolerable specifically due to the upgrade to DSS-27. (See Figures 2a, 2b and 2c) The following details each missions' results based on schedule and forecast data assembled:

- | | |
|--------------------|--|
| ACE: | ACE experiences some increased lost time but overall the mission maintains supportability albeit with some additional conflicts that requires negotiation. (See Figures 3a-3c) |
| Chandra: | Chandra experiences little or no negative impact from the DSS-16 closure as they are primarily supported by the 34BWG1 subnet, although increased utilization of the 34BWG1 subnet. (See Figures 4a-4c) |
| Cluster II: | Cluster II shows a minor impact to supportability that is due to its minimal requirements. What is difficult to express is the missions' requirement for simultaneous support of 4 spacecraft from multiple antennas. This is severely impacted by the DSS-16 closure as it reduces the number of antennas at Goldstone. (See Figures 5a-5c) |
| Geotail: | The Geotail mission suffers very little from the loss of DSS-16 primarily due to its minimal requirements and its ability to be supported from all DSN subnets except the 34BWG2. In most cases a reduction in lost time is seen due to not contending with DSS-16 utilization. (See Figures 6a-6c) |

- IMAGE:** IMAGE experiences little or no negative impact from the DSS-16 closure as they are primarily supported from Canberra due to their orbit which limits Northern hemisphere view. (See Figures 7a-7c)
- INTEGRAL:** INTEGRAL suffers very little from the loss of DSS-16 primarily due to its minimal requirements. (See Figures 8a-8c)
- Polar:** Polar experiences little or no negative impact from the DSS-16 closure as they are primarily supported from Canberra due to their orbit which limits Northern hemisphere view. (See Figures 9a-9c)
- SOHO:** The SOHO mission experiences some difficulty in obtaining full support when in normal operations due to a relatively higher support requirement, but is expected to fulfill requirement through negotiation with other missions. During SOHO “Keyhole” periods the mission has more difficulty but that is the case with or without DSS-16 in service. (See Figures 10a-10c)
- Wind:** Wind experiences little or no negative impact from the DSS-16 closure as they are primarily supported by the 34BWG1 subnet, although increased utilization of the 34BWG1 subnet may impact them. (See Figures 11a-11c)

Current Key Mission Requirements

- The apogee for both the POLAR and IMAGE missions occur over the Southern hemisphere. Due to this occurrence, DSS-34 and DSS-46 are the primary DSN resources utilized by these missions in order to meet their mission requirements.
- The ACE, CLUSTER II, Geotail, and SOHO missions all utilize the 26 meter subnet in order to meet their mission requirements
- 80% of CLUSTER II’s Wide-Band Data (WBD) Opportunities are in the southern hemisphere and require simultaneous tracking support from three to four apertures
- SOHO will be in their Keyhole period in:
 - Weeks 48 through 51 of 2005
 - Weeks 8 through 11 of 2006
 - Weeks 21 through 24 of 2006
 - Weeks 34 through 37 of 2006
 - Weeks 47 through 50 of 2006
- Mars Reconnaissance Orbiter (MRO) is scheduled to launch on 10 August 2005, DSS-16 and 46 support required for launch and initial acquisition.
- Stardust (SDU) Earth Re-entry Week 01 of 2006.
- New Horizon (NHPC) is scheduled to launch on January 10, 2006, DSS-46 support required for launch and initial acquisition.

- Stereo Ahead (A) and Behind (B) are scheduled to launch February 11, 2006, DSS-26 support required for launch and initial acquisition.
- Space Technology-5 (ST-5) is scheduled to launch on February 28, 2006, DSS-16 and 46 support required for launch, initial acquisition and early operations support (Post Maneuver Acquisition Aid) for approximately 10 days.
- Dawn is scheduled to launch no earlier than June 17, 2006 DSS-46 support required for launch, initial acquisition.
- GOES-O is scheduled to launch no earlier than April 01, 2007, 26 Meter support required for launch, initial acquisition, and early operations support for approximately 21 days.
- NOAA-N Prime (NO19) is scheduled to launch no earlier than March 1, 2008, 26 Meter support required for launch, initial acquisition, and early operations support for approximately 21 days.

Current mission requirements dictate the specific use of DSS-46, for both nominal activities and critical events. Therefore DSS-46 may not be available for offloading DSS-16 requirements. As a result of the 26 meter subnet closure some users may be able to offload support to the 34 meter or 70 meter subnets, but not all missions have this option and offloading creates further contention that the 34 and 70 meter subnets would not be able to absorb without a marked increase in unsupportable time.

Other major events and downtimes occurring during the study period are listed in the supporting data attached at the end of this study.

Conclusion

Based on current data gathered for this study including schedules built, through Week 52/2005 and an approximation of future schedules which will be built based on the current User Loading Profiles (ULP's) for all active missions, the DSN can provide most all of the currently requested support if DSS-16 is decommissioned after November 21, 2005, provided DSS-27 is upgraded to provide capabilities currently available at DSS-16 and that DSS-46 and 66 remain available.

Recommendations

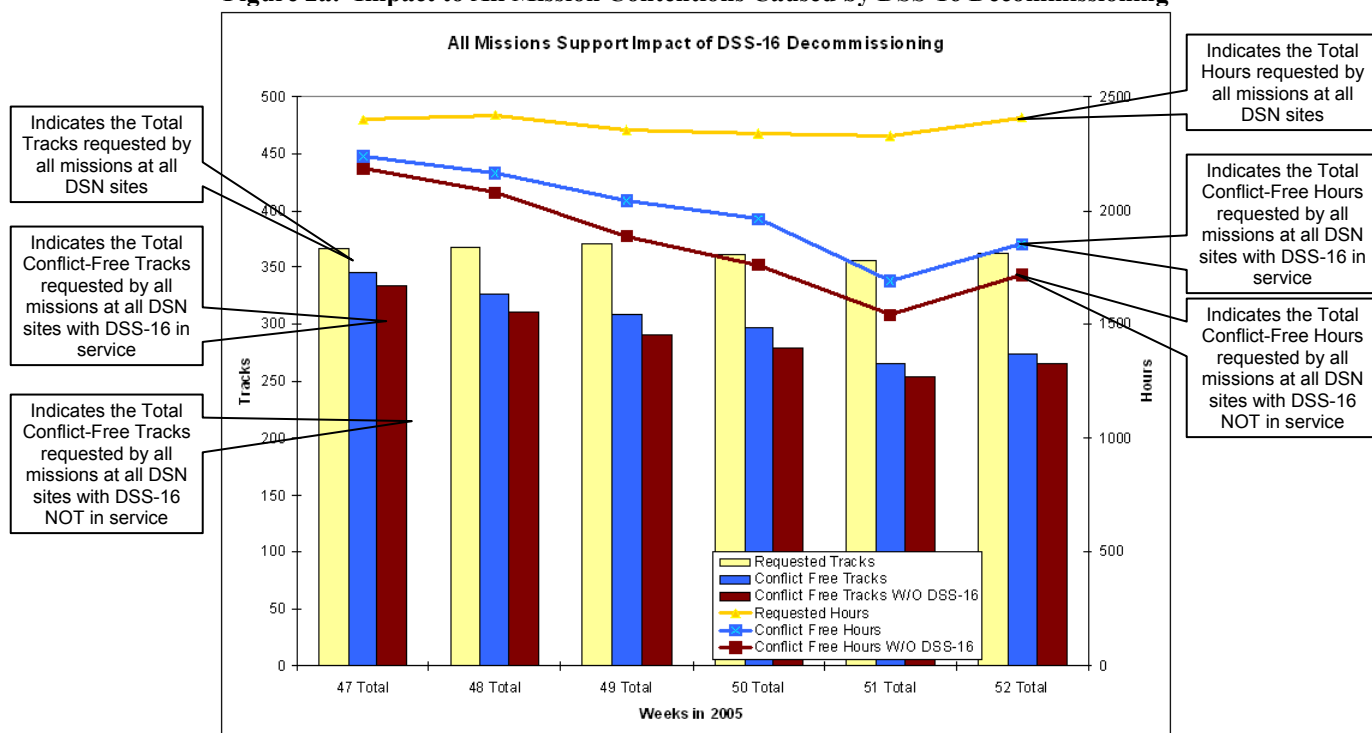
Based on this study case it is recommended that DSS-16 be decommissioned no earlier than week 47 of 2005 (November 21, 2005), after the DSS-15 downtime is completed and returned to service. Further it is recommended that DSS-27 be upgraded with full TT&C (NSP, SLE) and Acquisition Aid with Auto Tracking as there are still requirements for Acquisition Aid with Auto Tracking at Goldstone.

Supporting Data

Figure 1: DSN 26 Meter User Mission Set

DSN 26 Meter Mission Set					As of: June 6, 2005
Project	Acronym	Launch or Start	EOPM	EOEM	
Geotail	GTL	07/24/92	07/24/95	09/30/06	
Wind	WIND	11/01/94	11/01/97	12/31/06	
SOHO	SOHO	12/02/95	05/02/98	12/31/08	
Polar	POLR	02/22/96	08/23/97	12/31/06	
Advance Composition Explorer	ACE	08/25/97	02/01/01	09/30/10	
Chandra X-ray Observatory	CHDR	07/23/99	07/24/09	07/24/14	
Imager for Magnetopause-to-Aurora Global Exploration	IMAG	03/25/00	05/30/02	09/30/10	
Cluster 2 - S/C #2 (Samba)	CLU2	07/16/00	02/15/03	12/31/09	
Cluster 2 - S/C #3 (Rumba)	CLU3	07/16/00	02/15/03	12/31/09	
Cluster 2 - S/C #1 (Salsa)	CLU1	08/09/00	02/15/03	12/31/09	
Cluster 2 - S/C #4 (Tango)	CLU4	08/09/00	02/15/03	12/31/09	
International Gamma Ray Astrophysics Lab	INTG	10/17/02	12/18/04	12/31/08	

Figure 2a: Impact to All Mission Contentions Caused by DSS-16 Decommissioning



Note: This chart is designed to illustrate to the reader the increase in contention caused by the DSS-16 decommissioning. An increase in conflicts causes users more difficulty in fulfilling requirements.

Figure 2b: Impact to All Mission Supportable and Lost Time in 2006

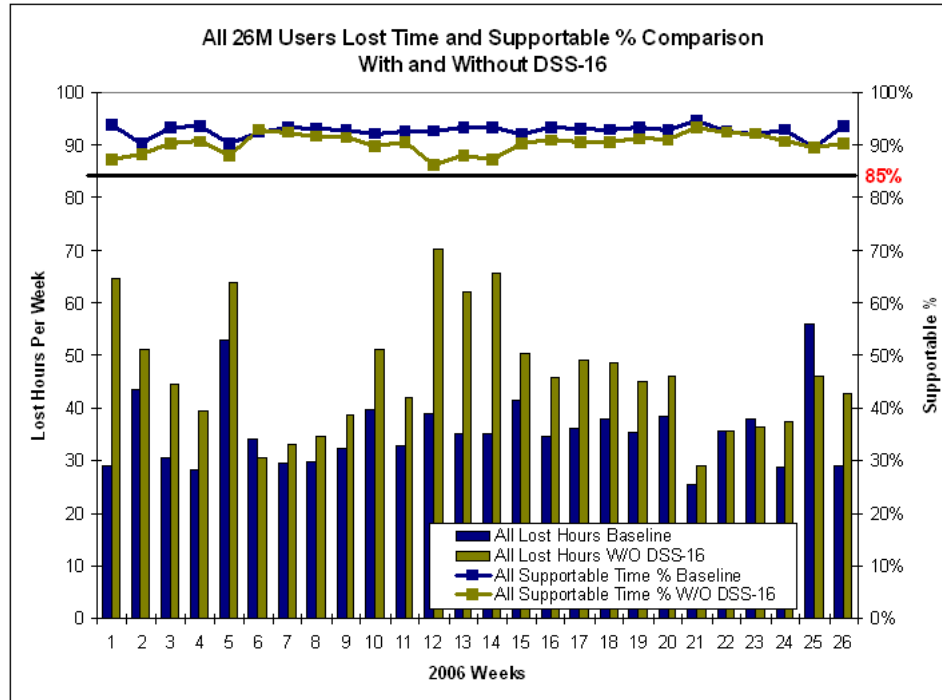


Figure 2c: Impact to All Mission Supportable and Lost Time in 2006

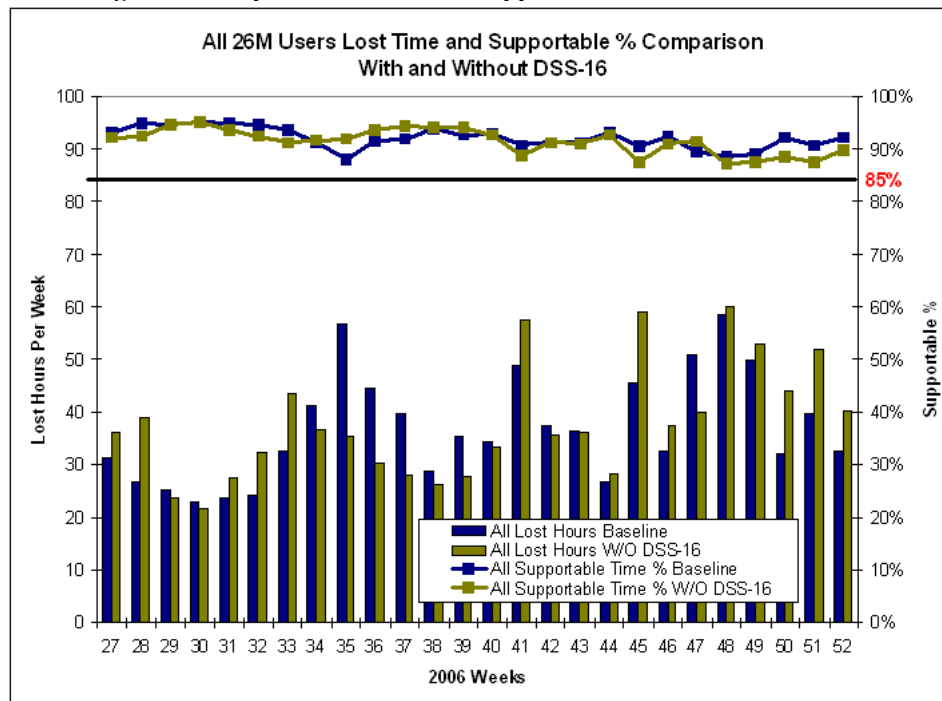


Figure 3a: Impact to Contentions Caused by DSS-16 Decommissioning for ACE

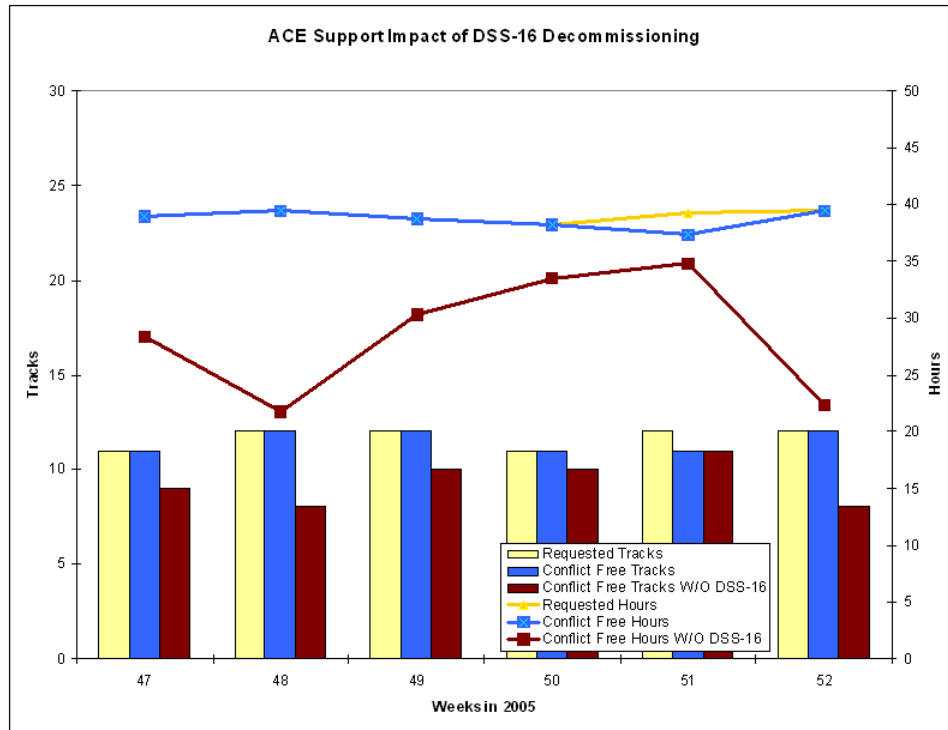


Figure 3b: Impact to ACE Supportable and Lost Time in 2006

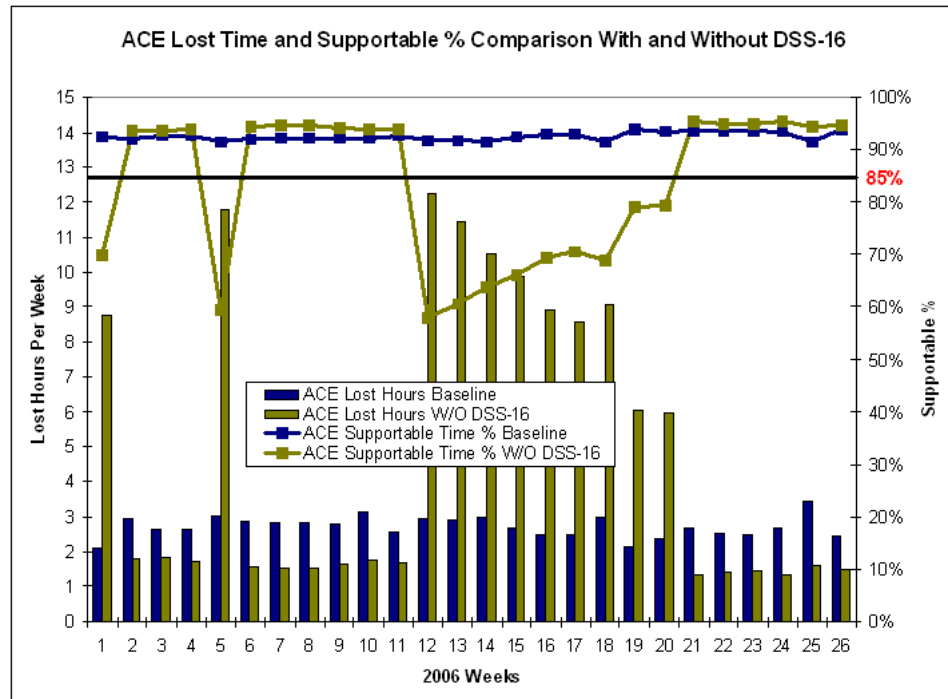


Figure 3c: Impact to ACE Supportable and Lost Time in 2006

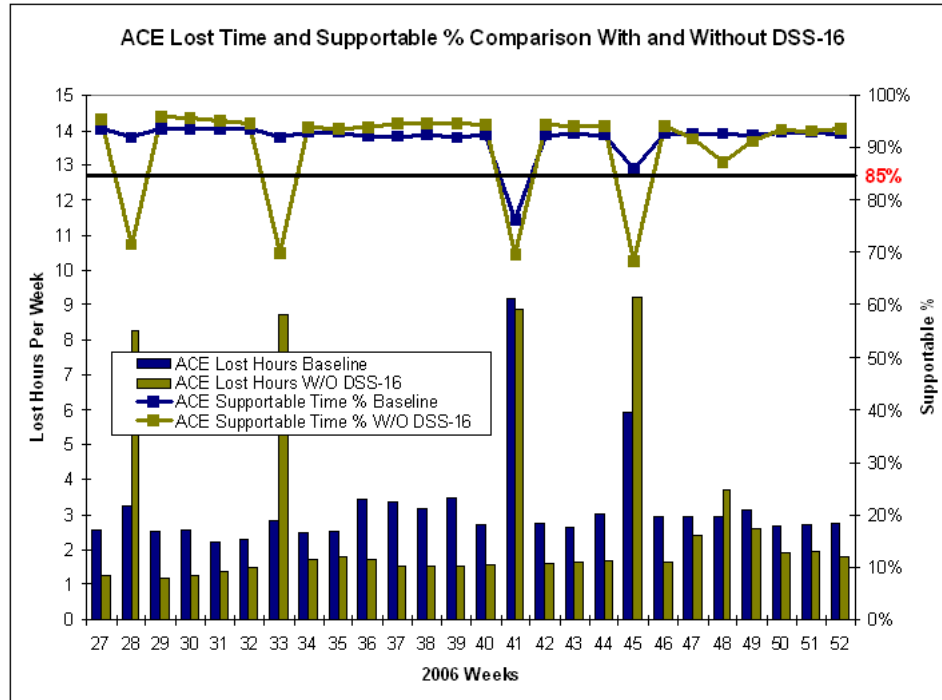


Figure 4a: Impact to Contentions Caused by DSS-16 Decommissioning for Chandra

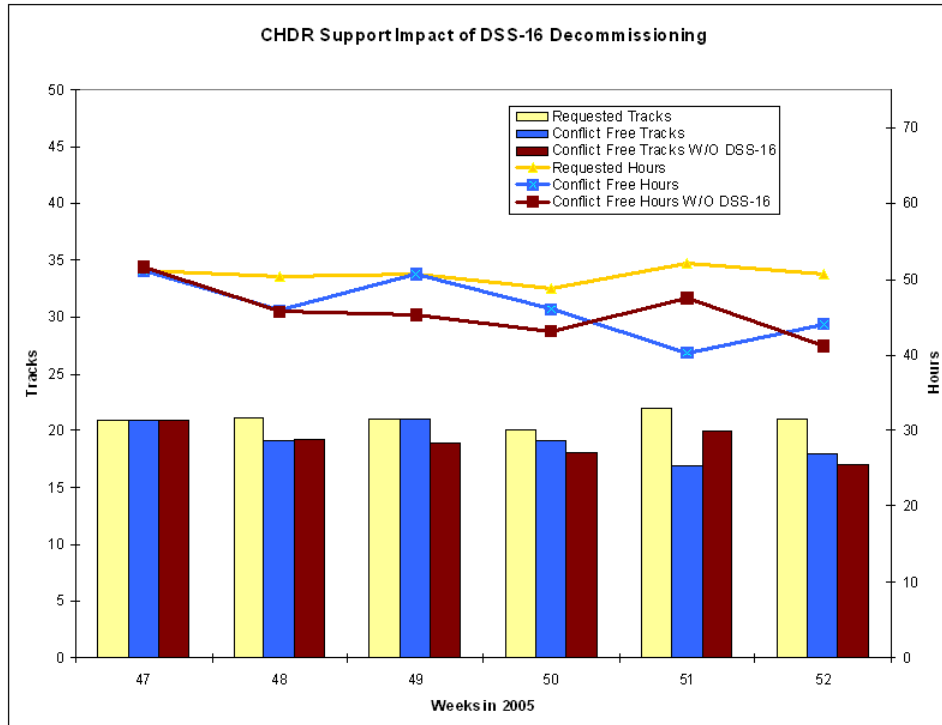


Figure 4b: Impact to Chandra Supportable and Lost Time in 2006

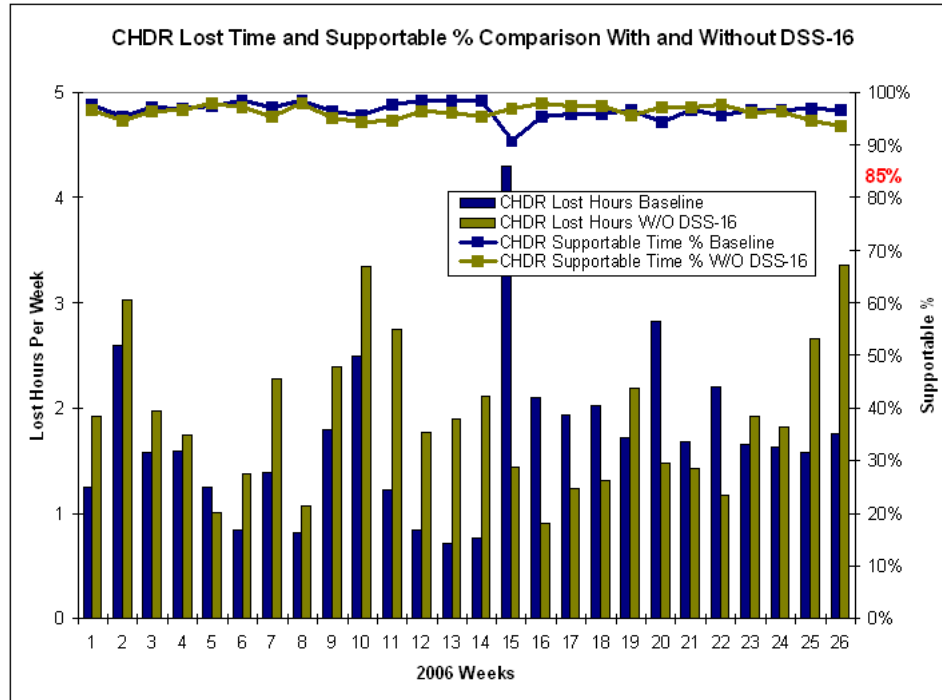


Figure 4c: Impact to Chandra Supportable and Lost Time in 2006

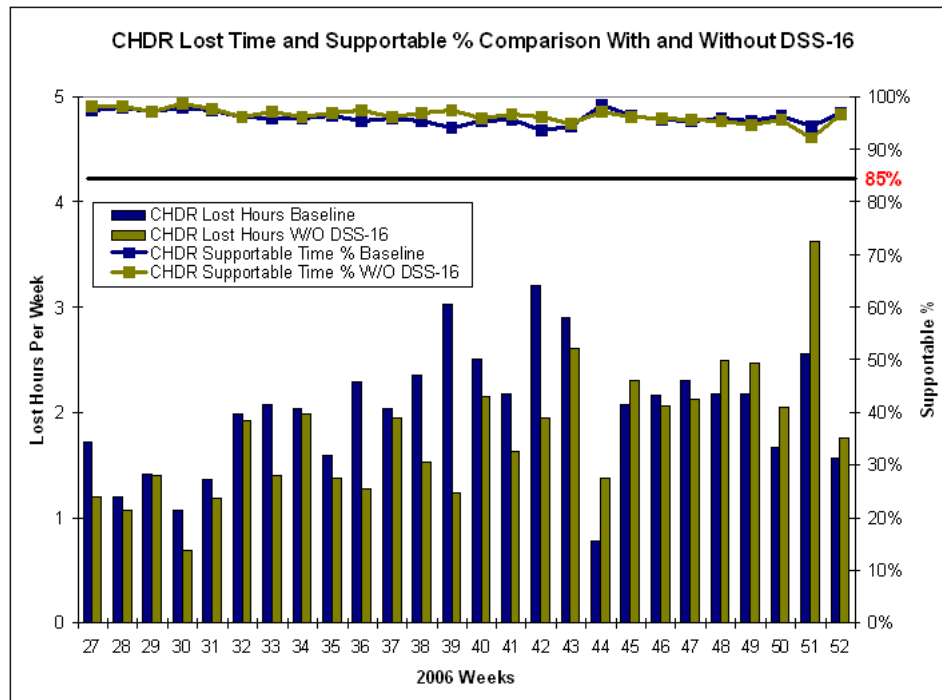


Figure 5a: Impact to Contentions Caused by DSS-16 Decommissioning for Cluster

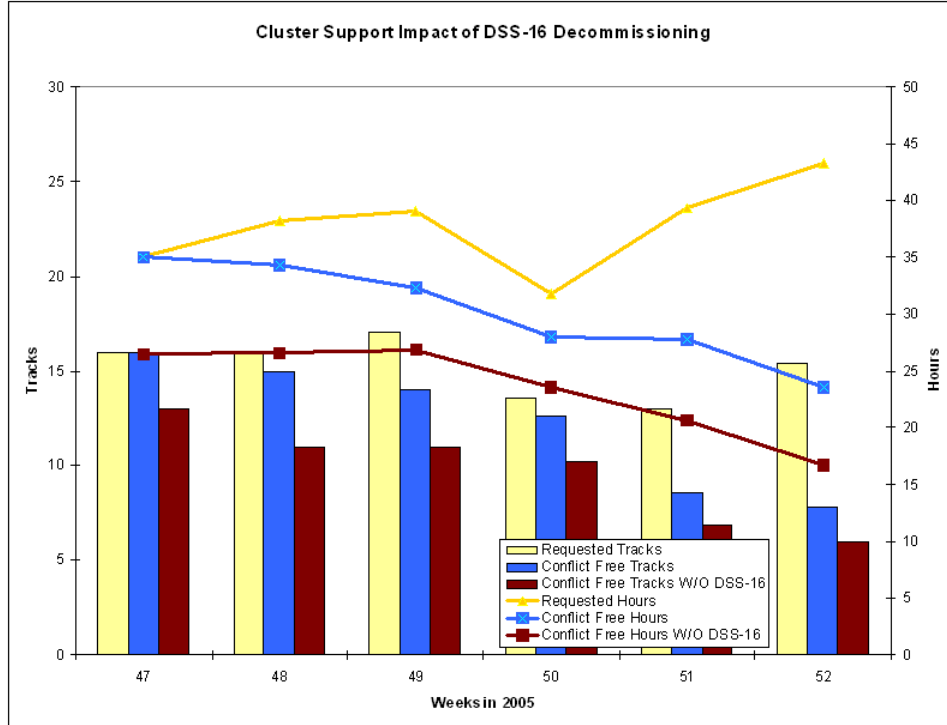


Figure 5b: Impact to Cluster Supportable and Lost Time in 2006

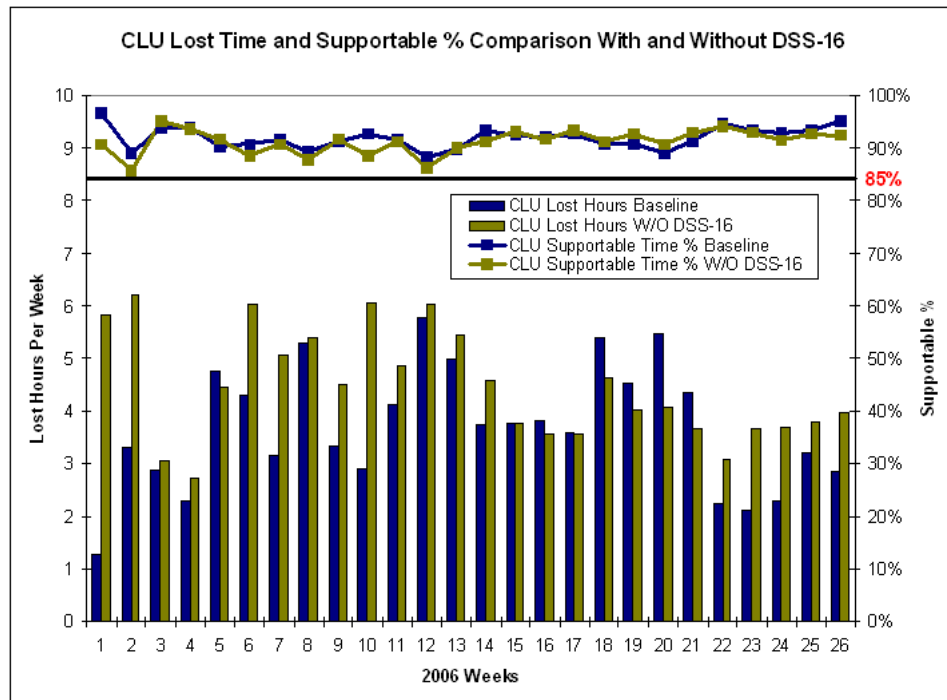


Figure 5c: Impact to CLU Supportable and Lost Time in 2006

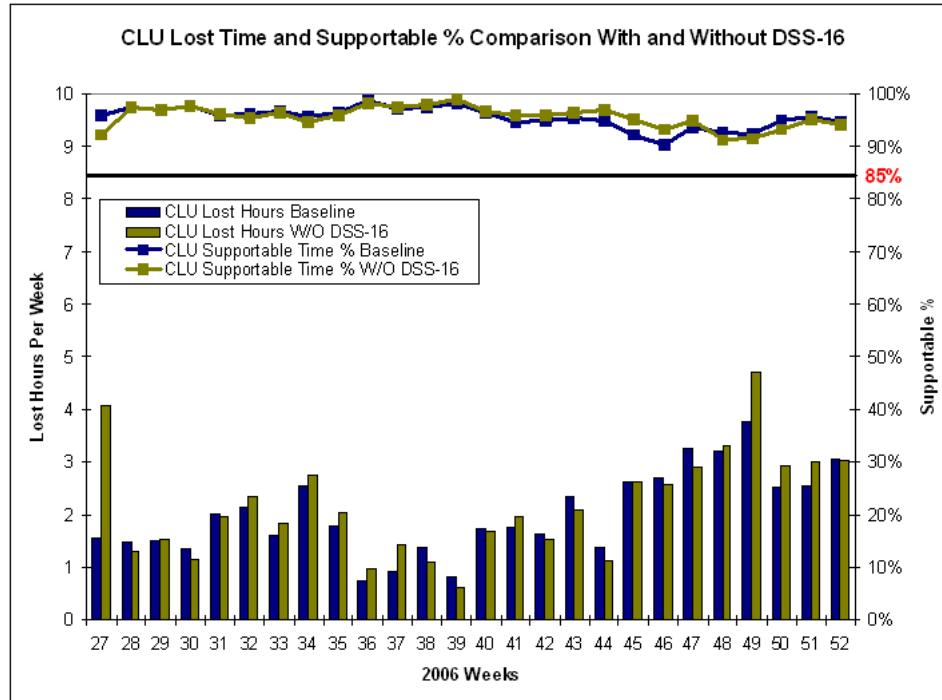


Figure 6a: Impact to Contentions Caused by DSS-16 Decommissioning for Geotail

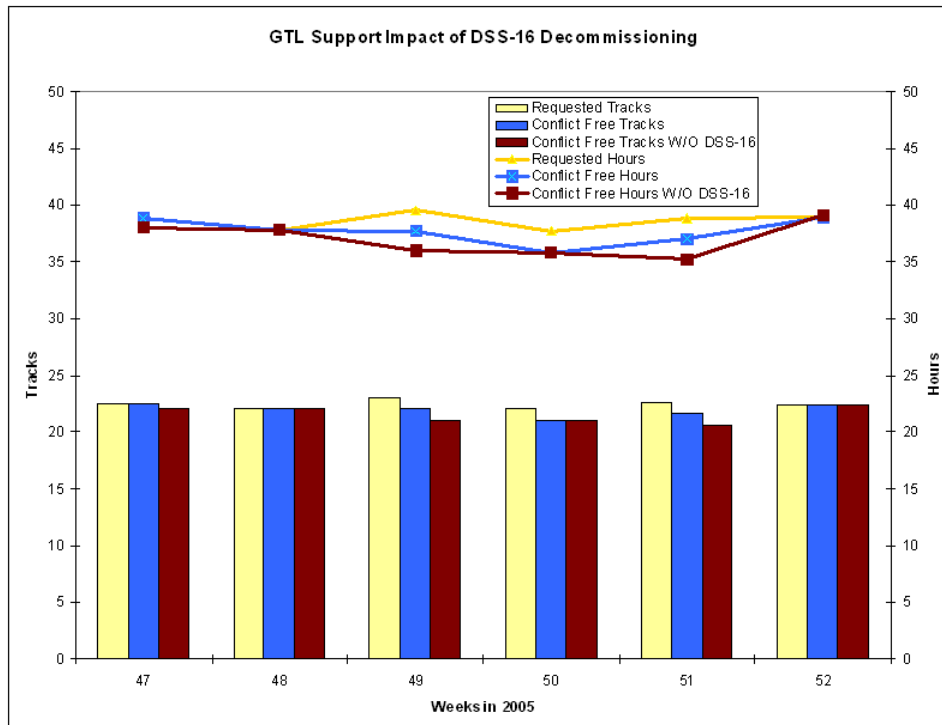


Figure 6b: Impact to Geotail Supportable and Lost Time in 2006

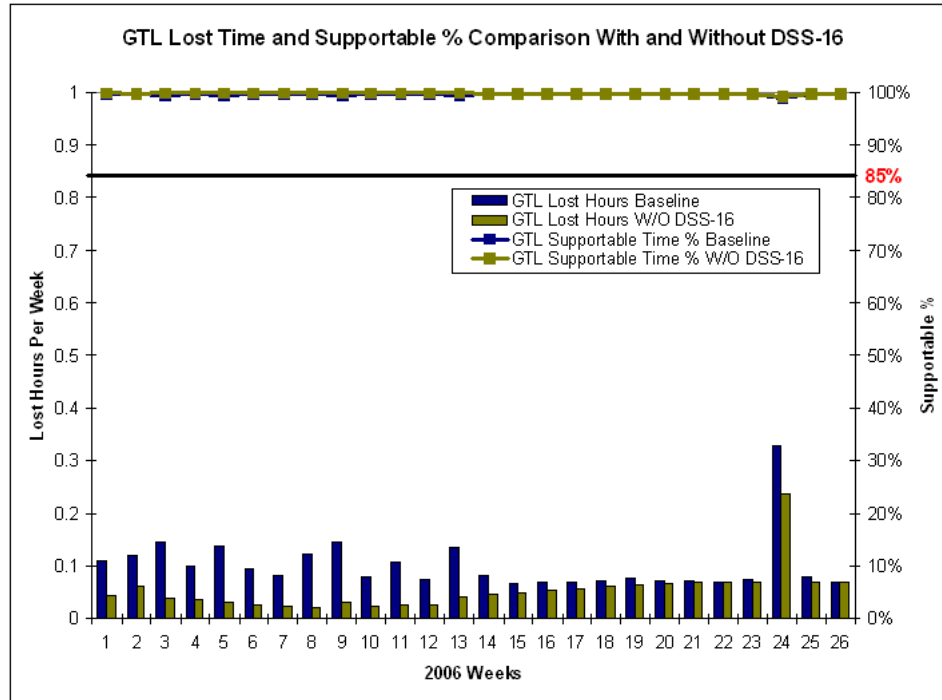


Figure 6b: Impact to Geotail Supportable and Lost Time in 2006

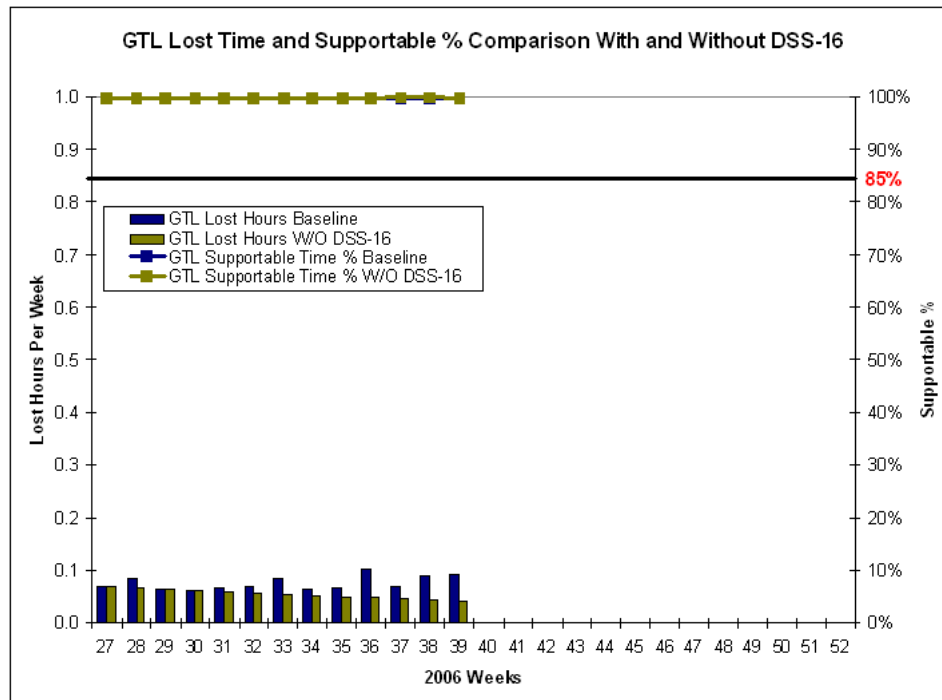


Figure 7a: Impact to Contentions Caused by DSS-16 Decommissioning for IMAGE

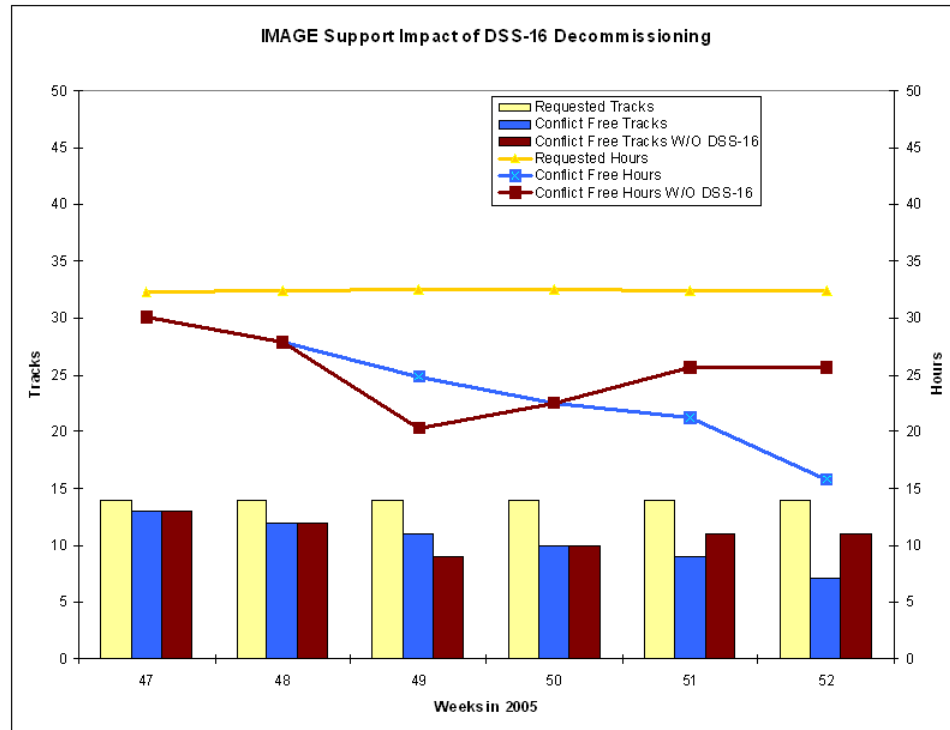


Figure 7b: Impact to IMAGE Supportable and Lost Time in 2006

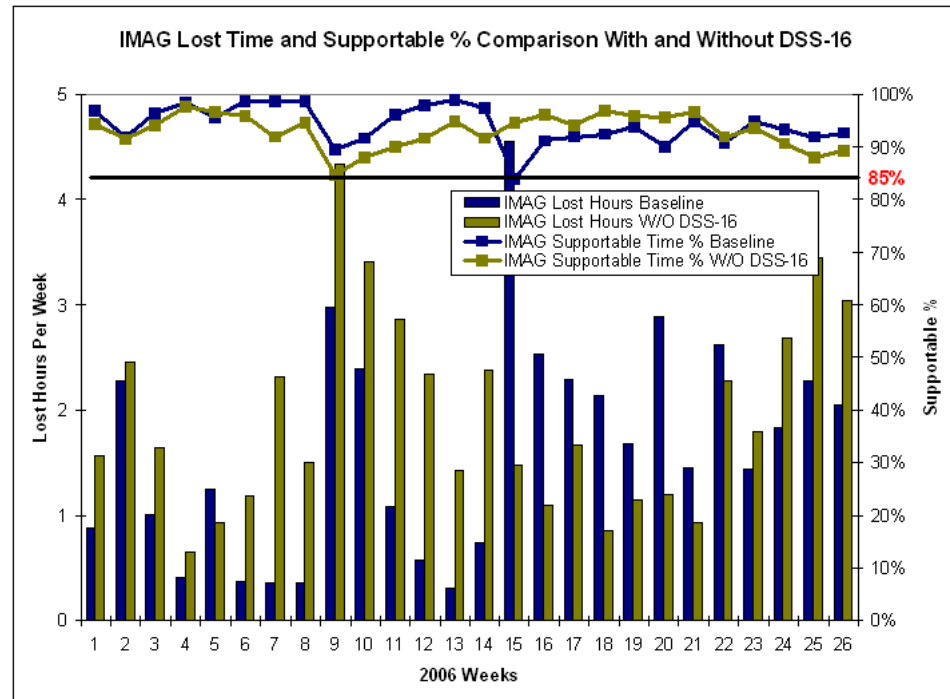


Figure 7c: Impact to IMAGE Supportable and Lost Time in 2006

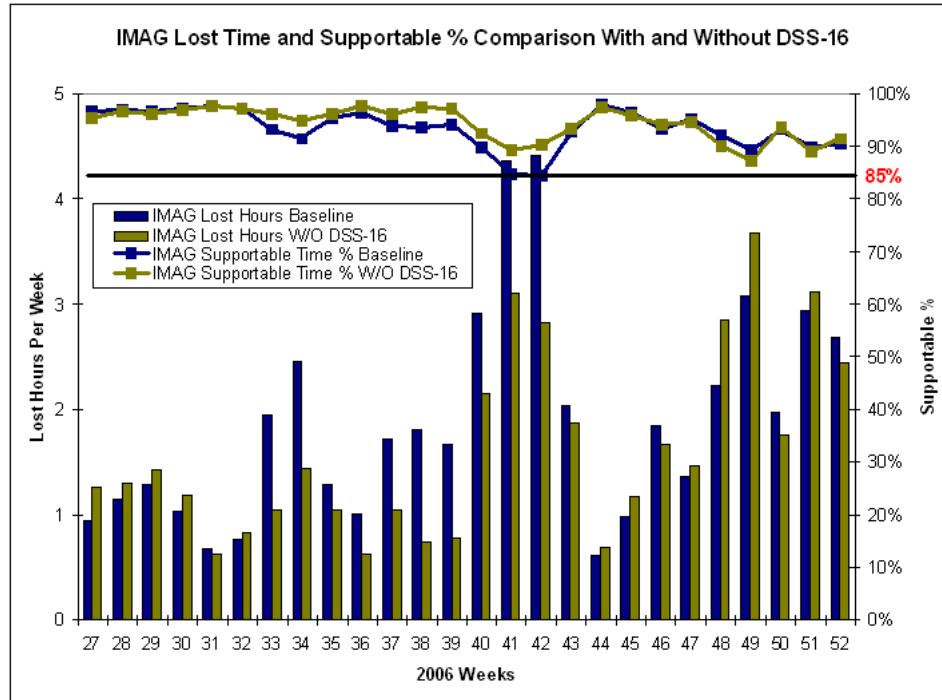


Figure 8a: Impact to Contentions Caused by DSS-16 Decommissioning for INTEGRAL

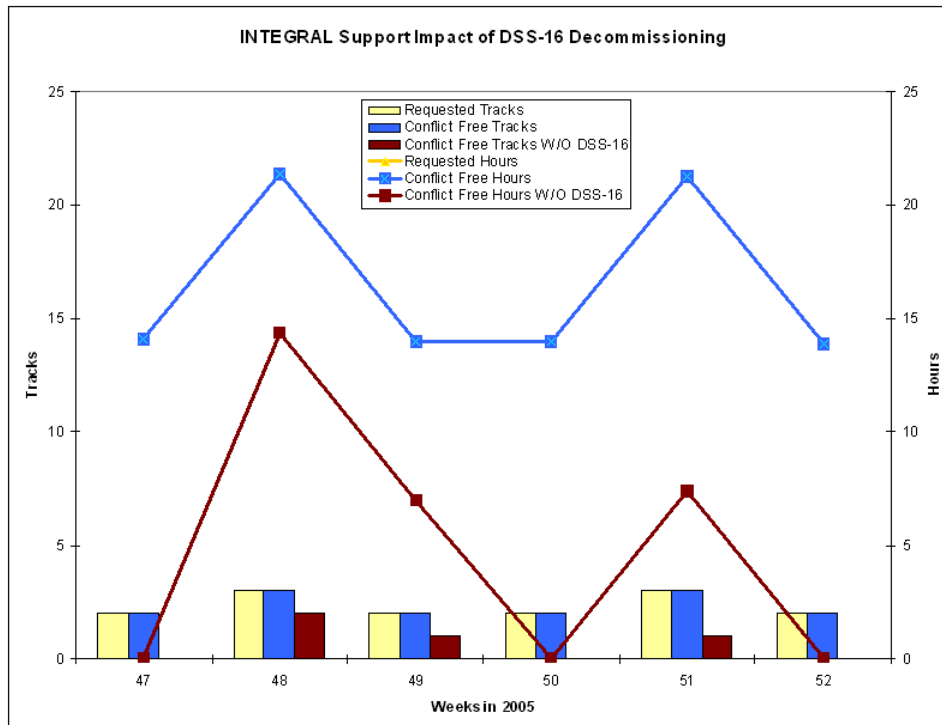


Figure 8b: Impact to INTEGRAL Supportable and Lost Time in 2006

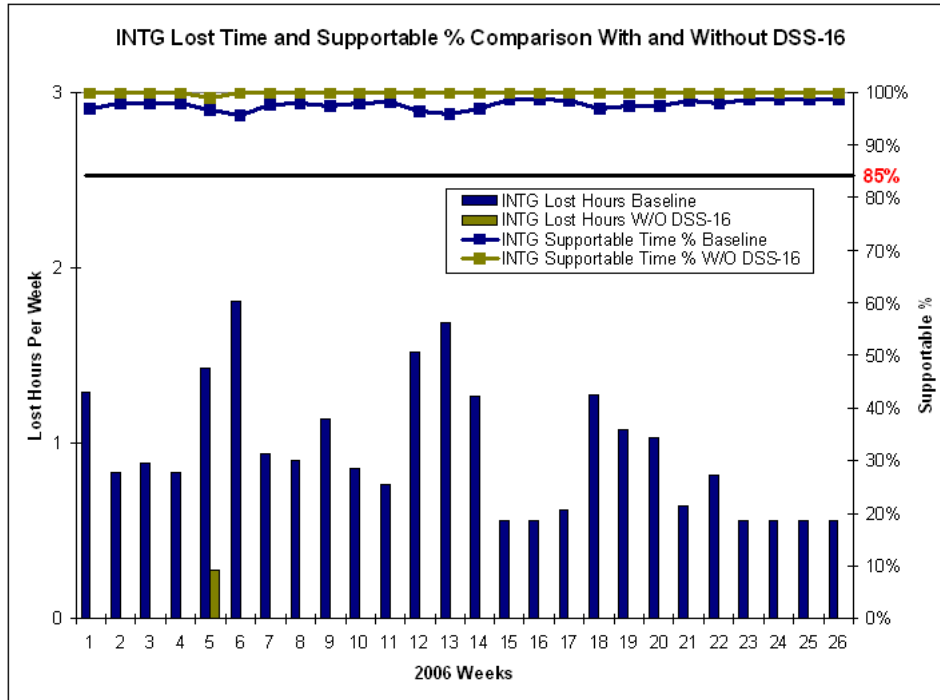


Figure 8c: Impact to INTEGRAL Supportable and Lost Time in 2006

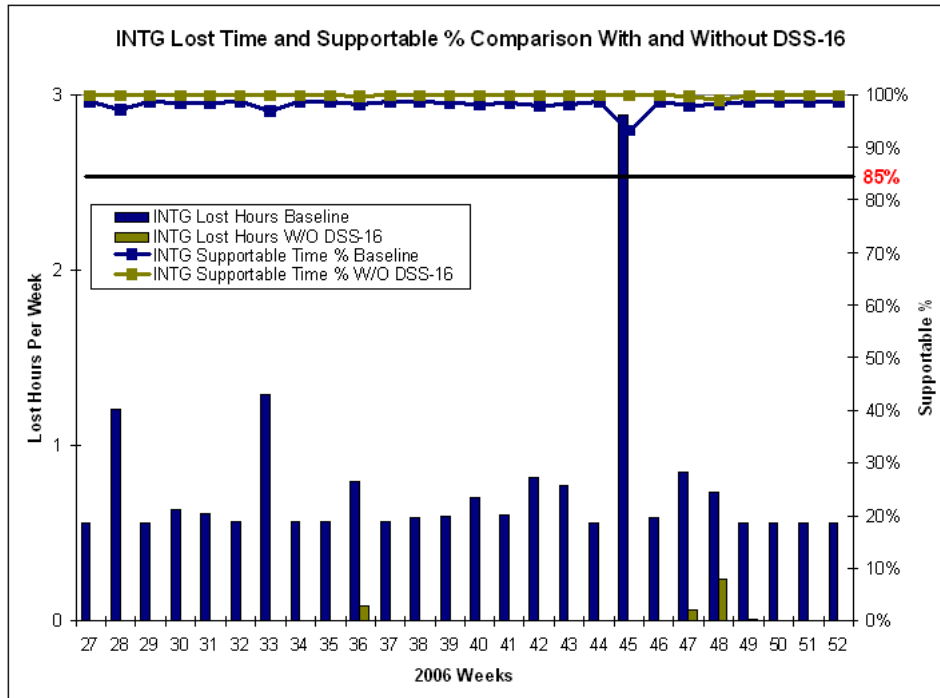


Figure 9a: Impact to Contentions Caused by DSS-16 Decommissioning for Polar

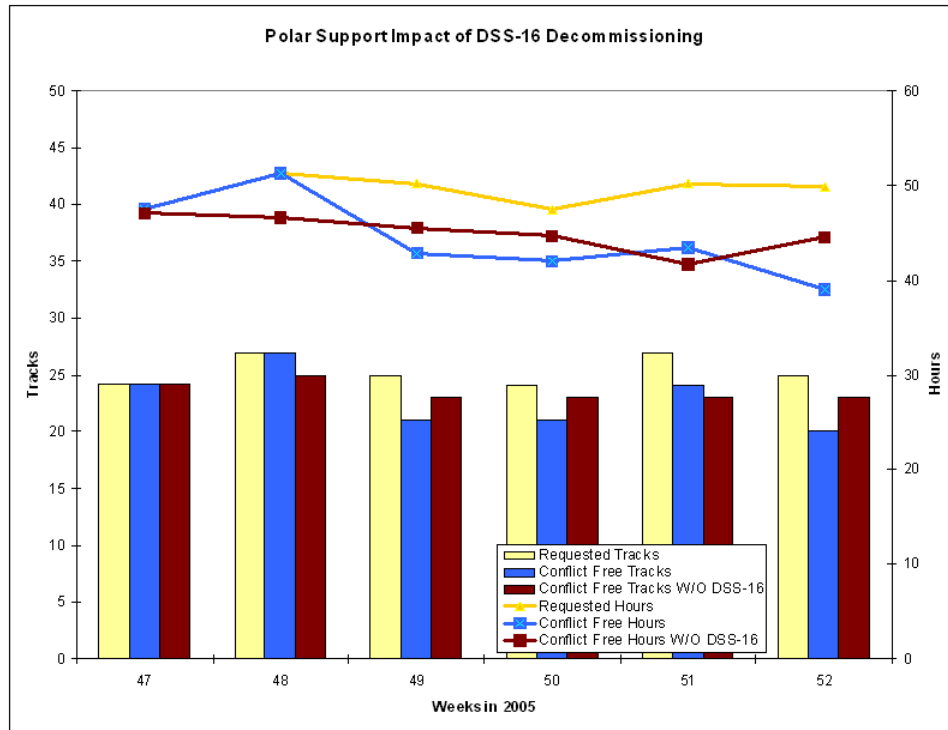


Figure 9b: Impact to POLAR Supportable and Lost Time in 2006

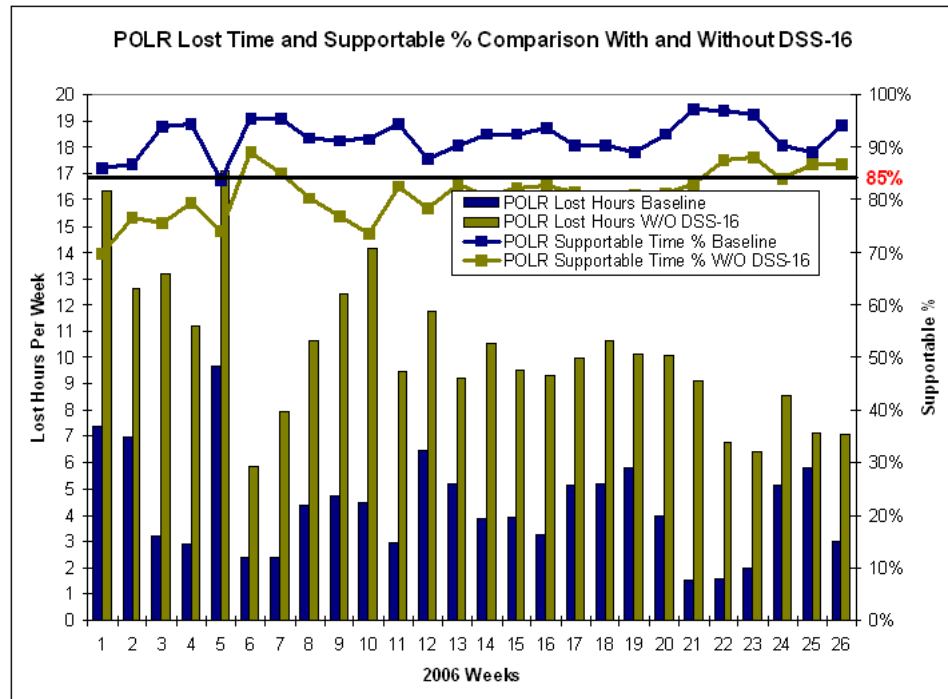


Figure 9c: Impact to POLAR Supportable and Lost Time in 2006

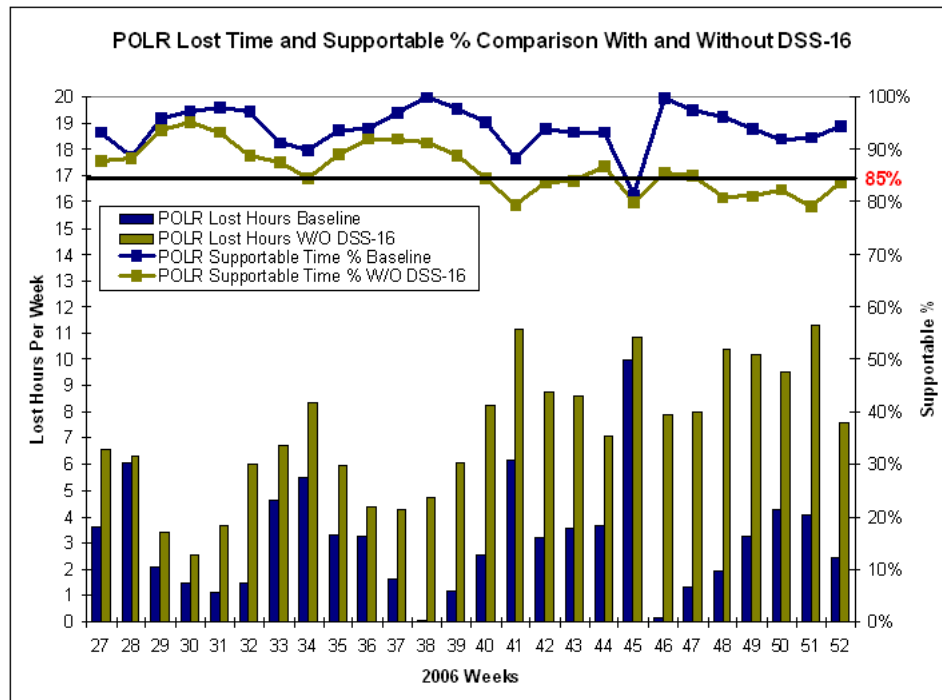


Figure 10a: Impact to Contentions Caused by DSS-16 Decommissioning for SOHO

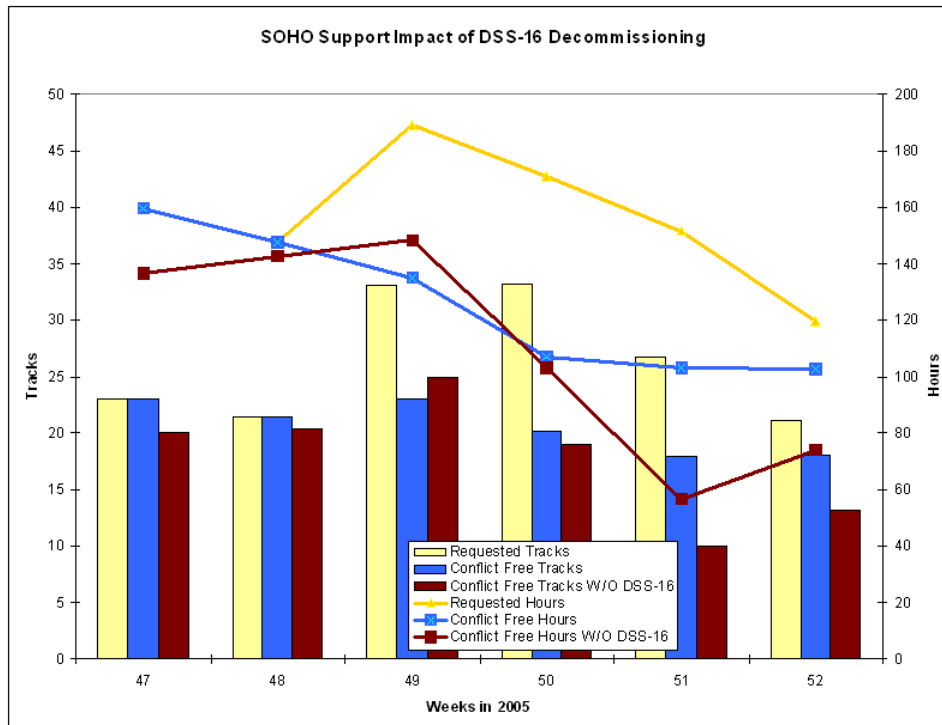


Figure10b: Impact to SOHO Supportable and Lost Time in 2006

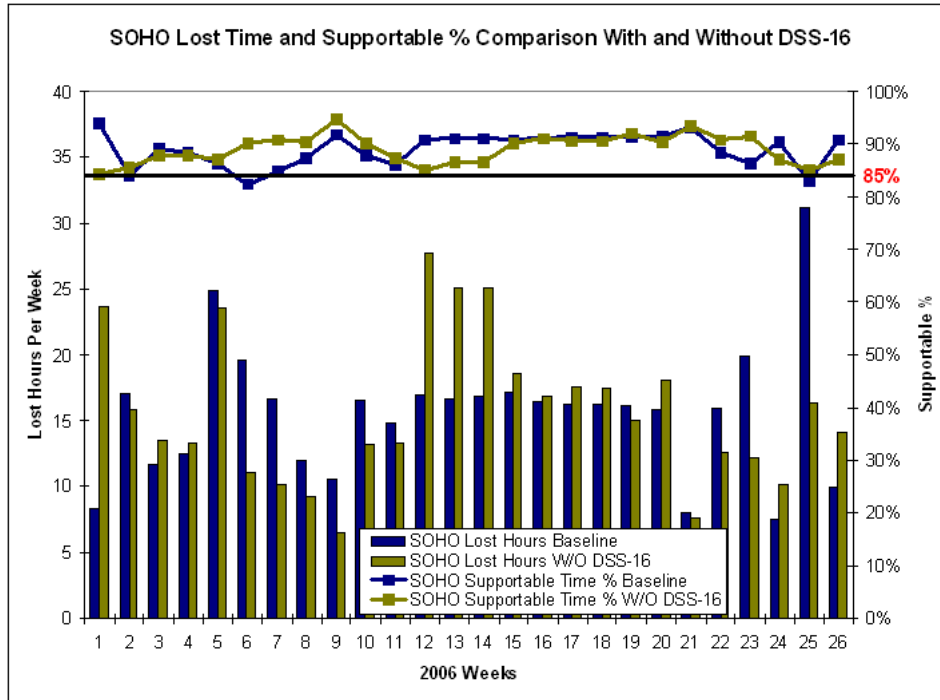


Figure10c: Impact to SOHO Supportable and Lost Time in 2006

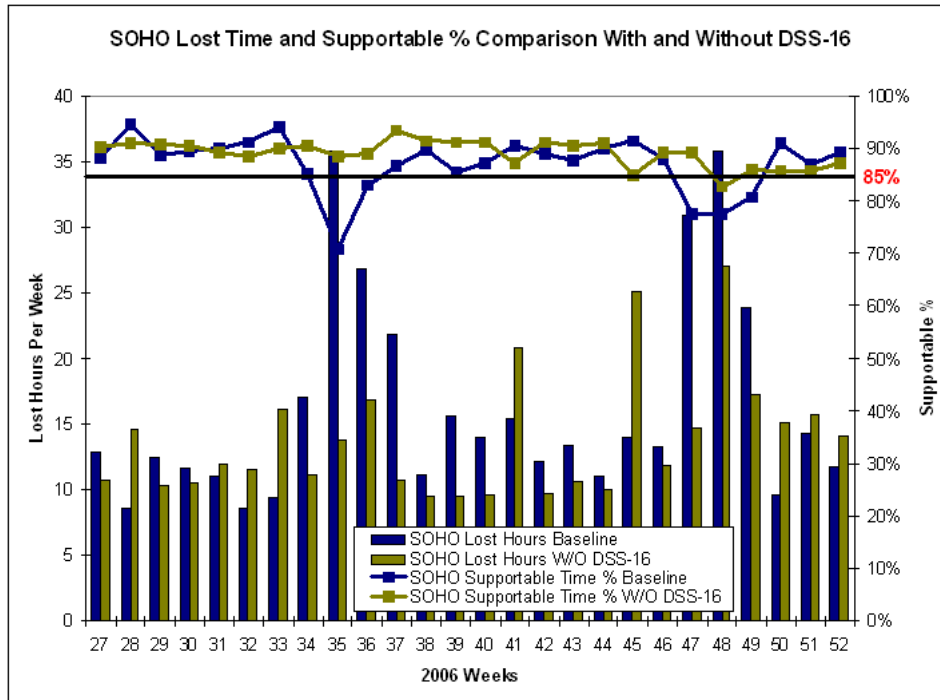


Figure 11a: Impact to Contentions Caused by DSS-16 Decommissioning for WIND

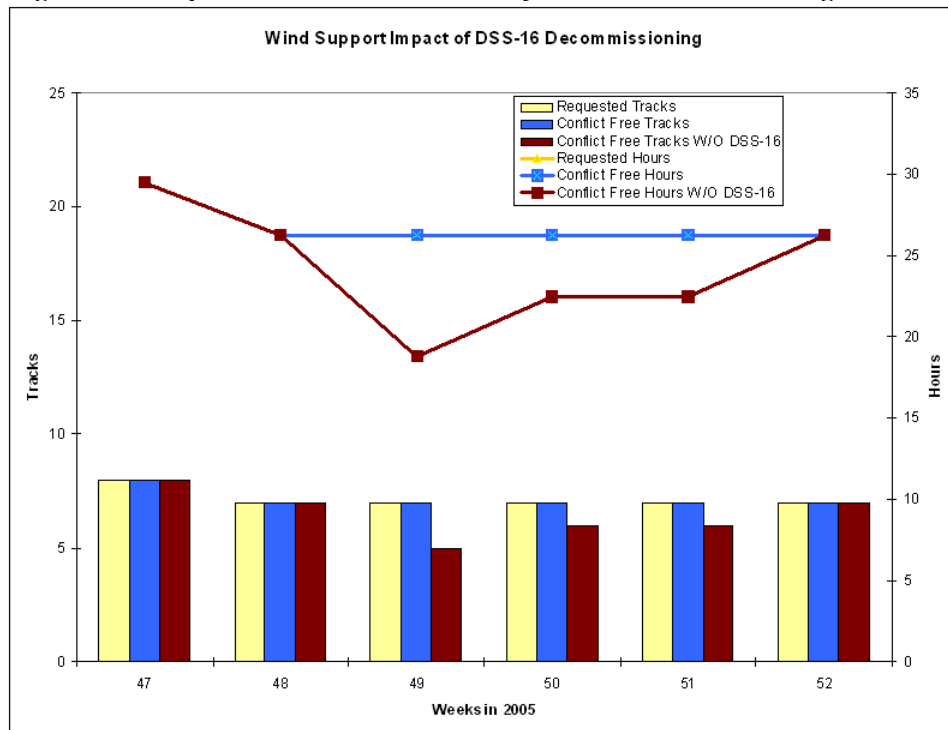


Figure11b: Impact to Wind Supportable and Lost Time in 2006

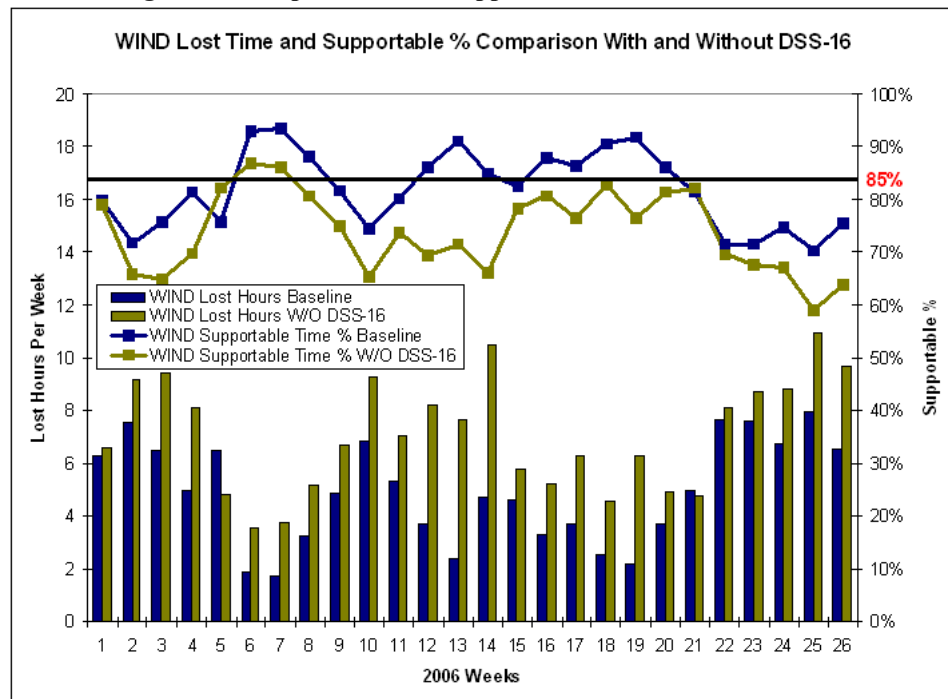


Figure11c: Impact to Wind Supportable and Lost Time in 2006

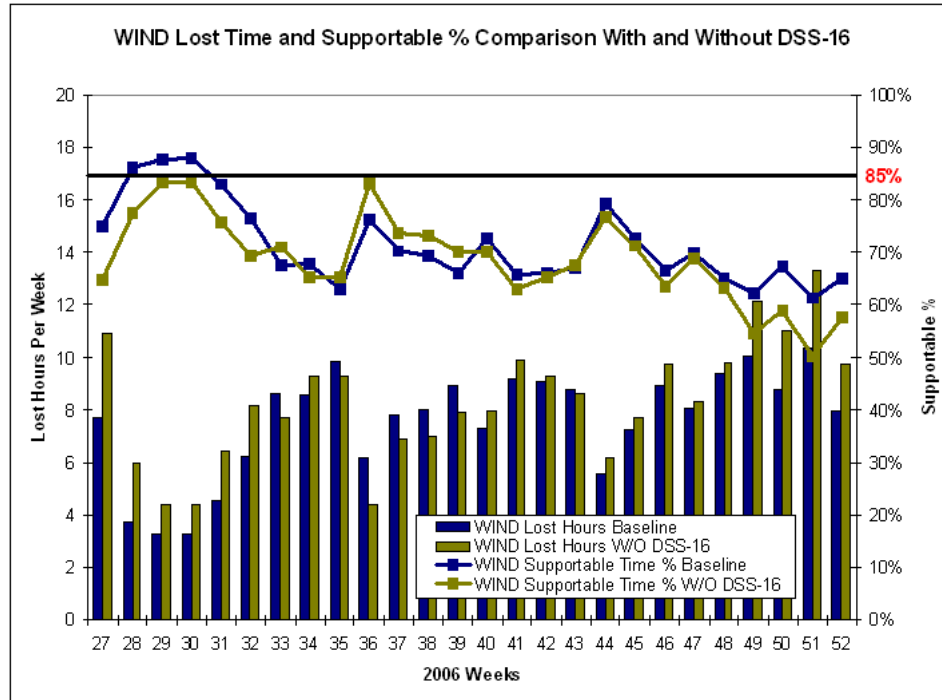


Figure 12: 34BWG1 Impact to Supportable and Requested Time from DSS-16 Decommissioning

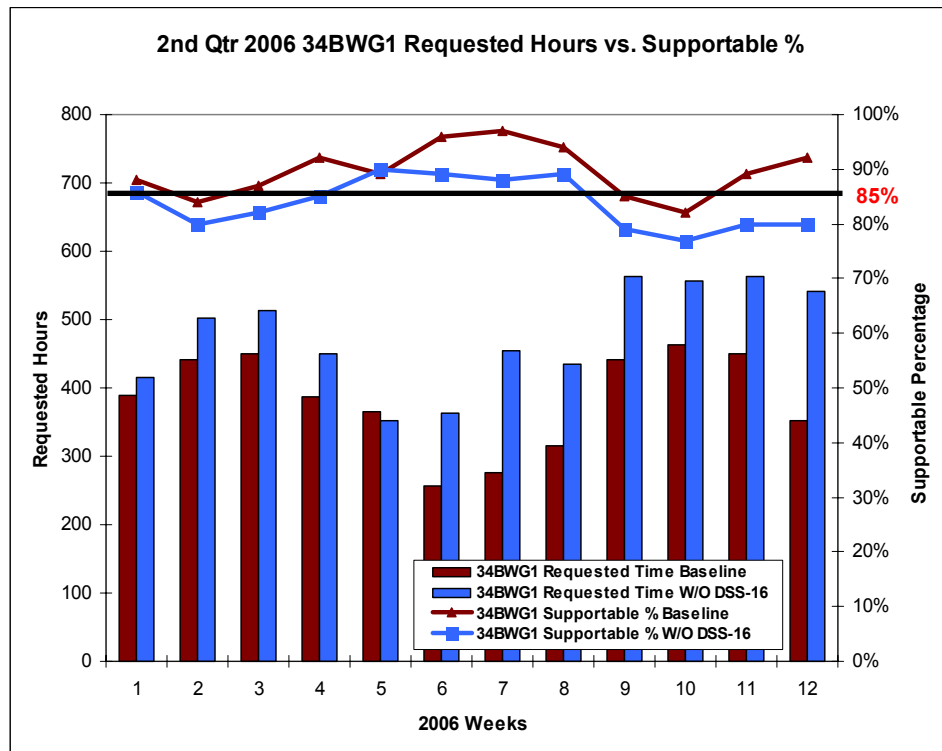


Figure 13: 34BWG1 Impact to Supportable and Requested Time from DSS-16 Decommissioning

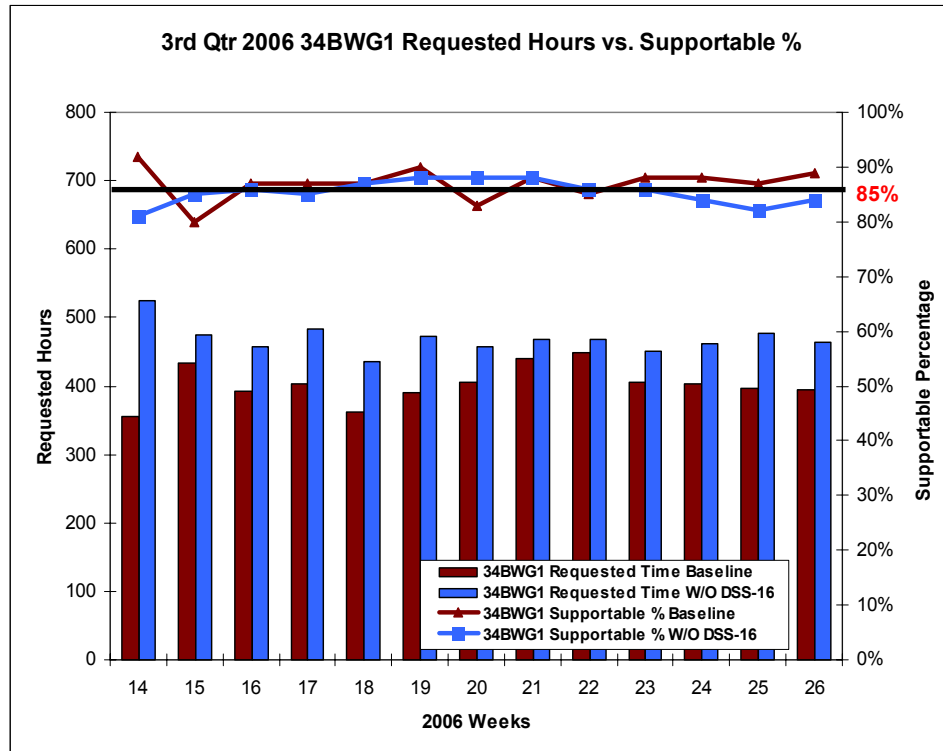


Figure 14: 34BWG1 Impact to Supportable and Requested Time from DSS-16 Decommissioning

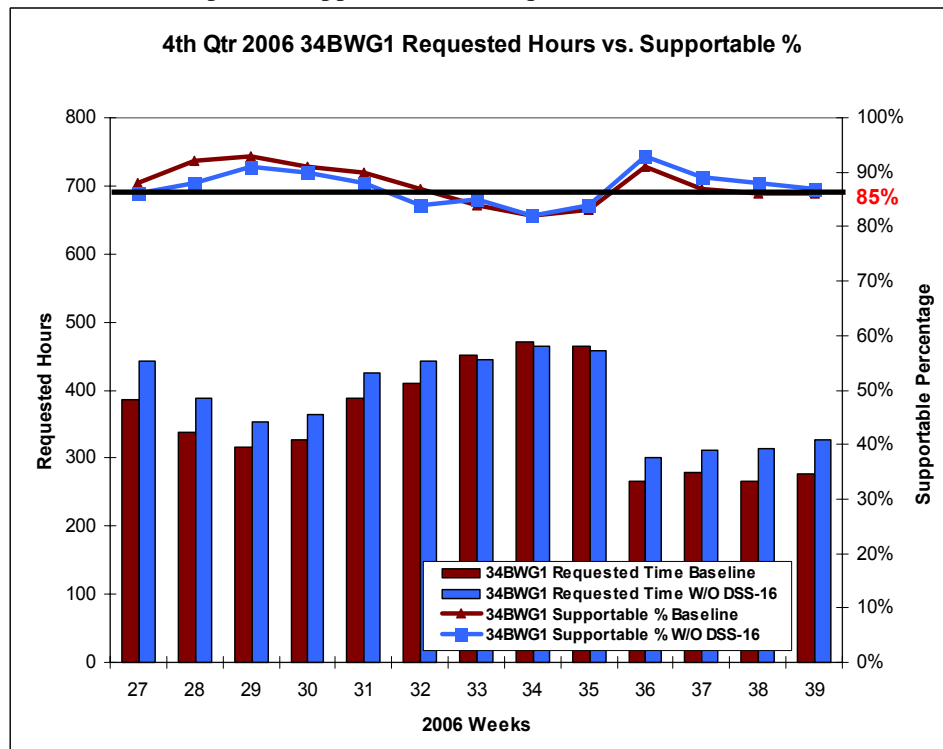


Figure 15: 34BWG1 Impact to Supportable and Requested Time from DSS-16 Decommissioning

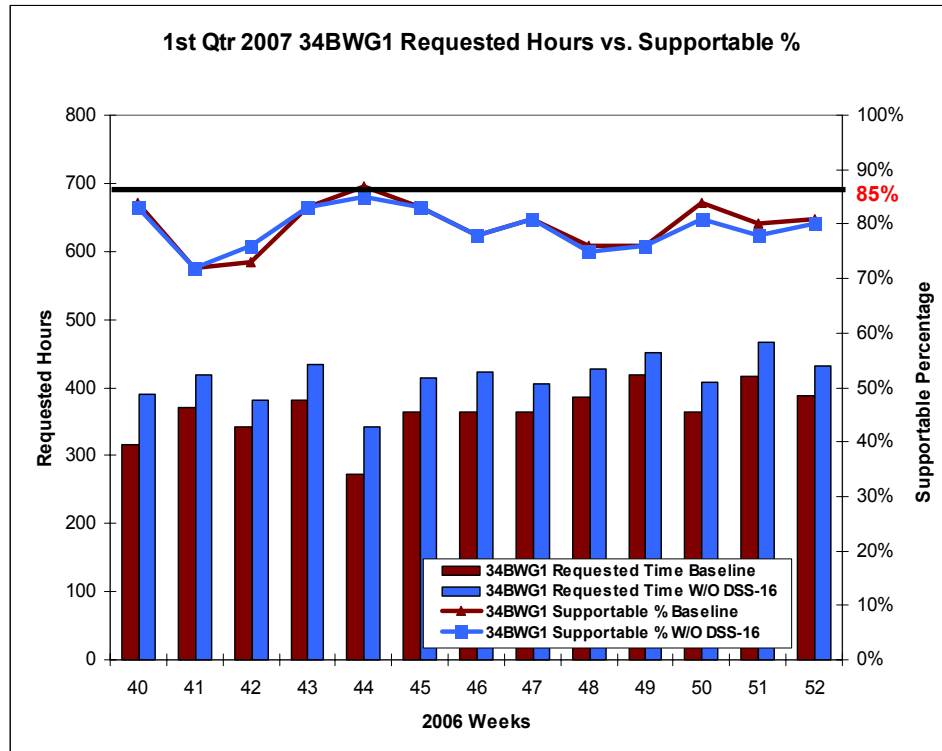


Figure 16: 34HSB Impact to Supportable and Requested Time from DSS-16 Decommissioning

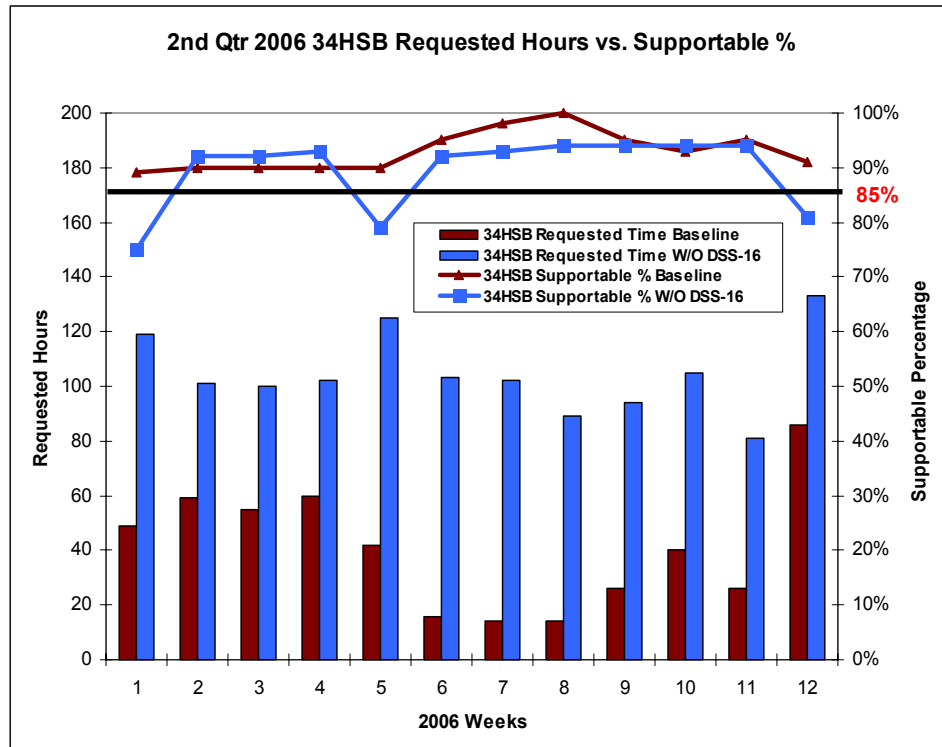


Figure 17: 34HSB Impact to Supportable and Requested Time from DSS-16 Decommissioning

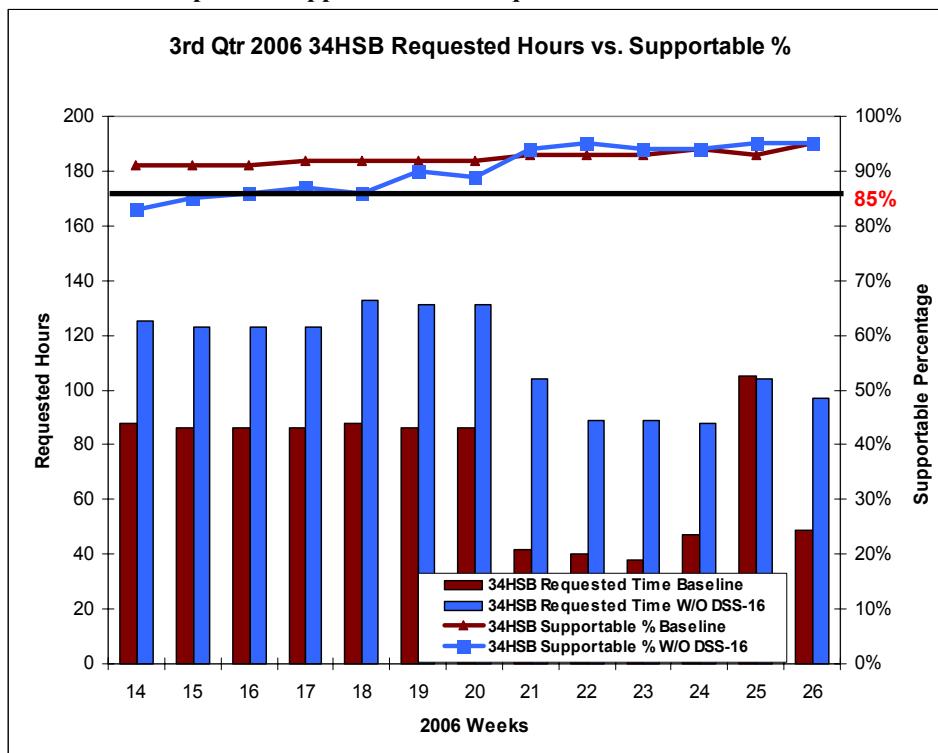


Figure 18: 34HSB Impact to Supportable and Requested Time from DSS-16 Decommissioning

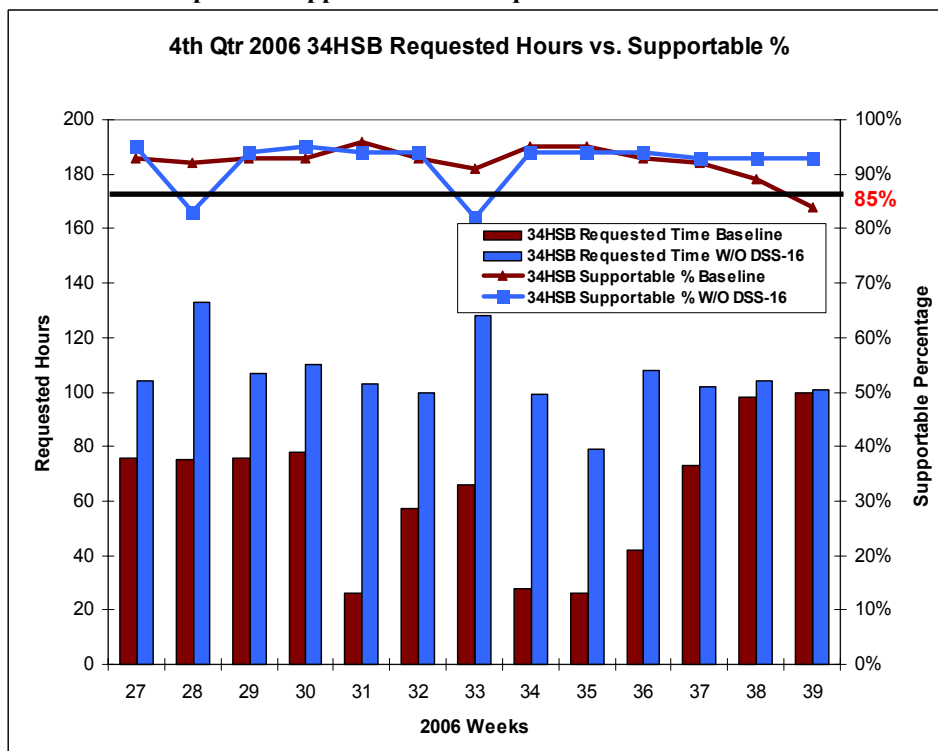


Figure 19: 34HSB Impact to Supportable and Requested Time from DSS-16 Decommissioning

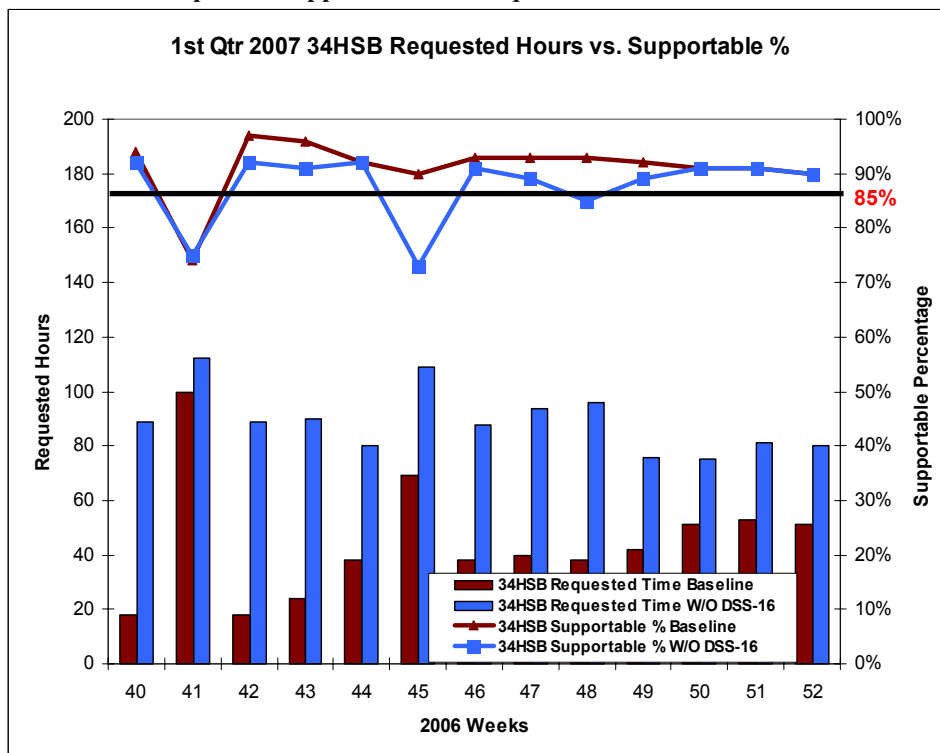


Figure 20: 26M Impact to Supportable and Requested Time from DSS-16 Decommissioning

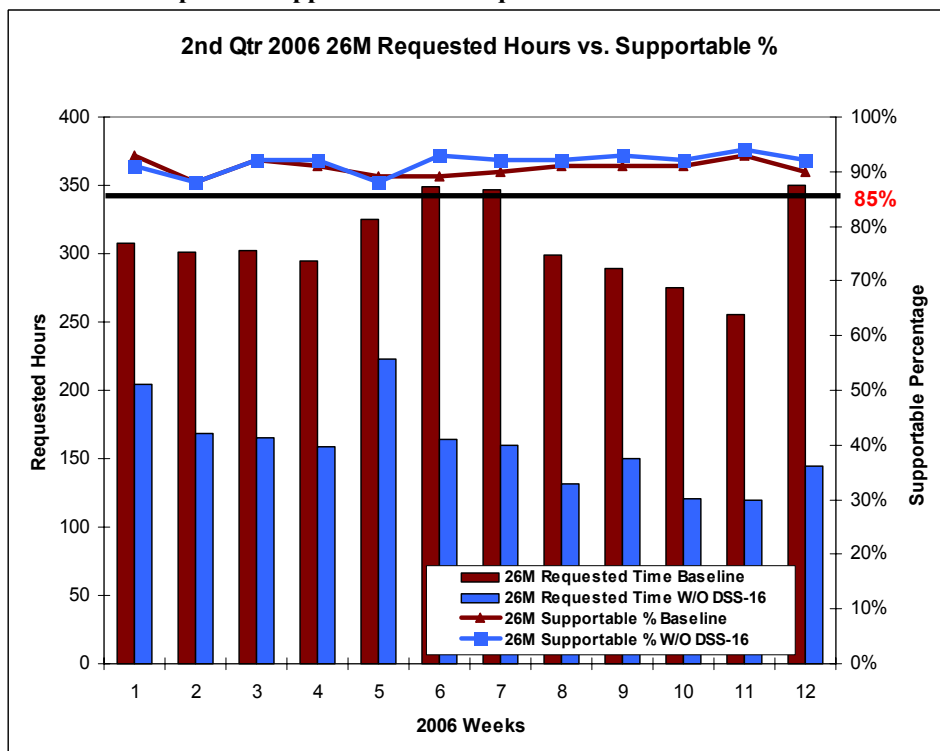


Figure 21: 26M Impact to Supportable and Requested Time from DSS-16 Decommissioning

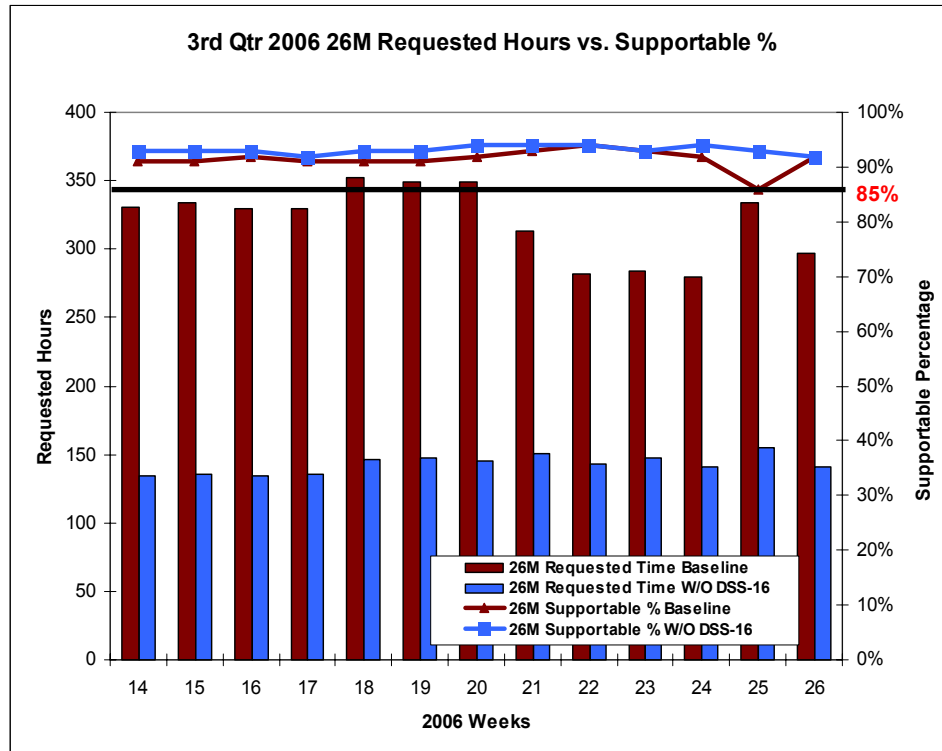


Figure 22: 26M Impact to Supportable and Requested Time from DSS-16 Decommissioning

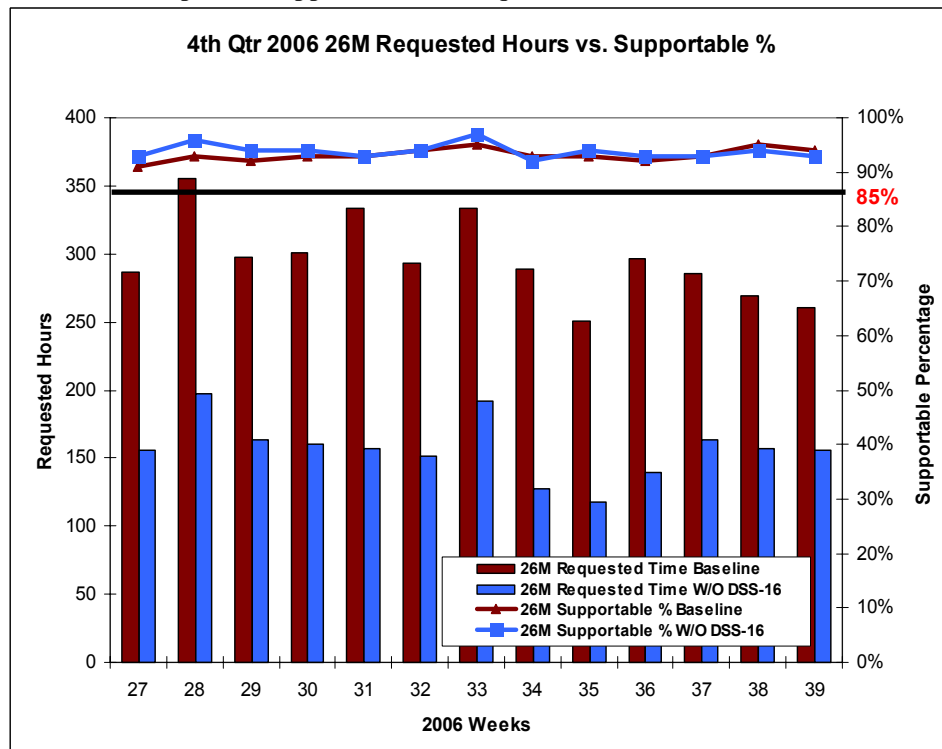


Figure 23: 26M Impact to Supportable and Requested Time from DSS-16 Decommissioning

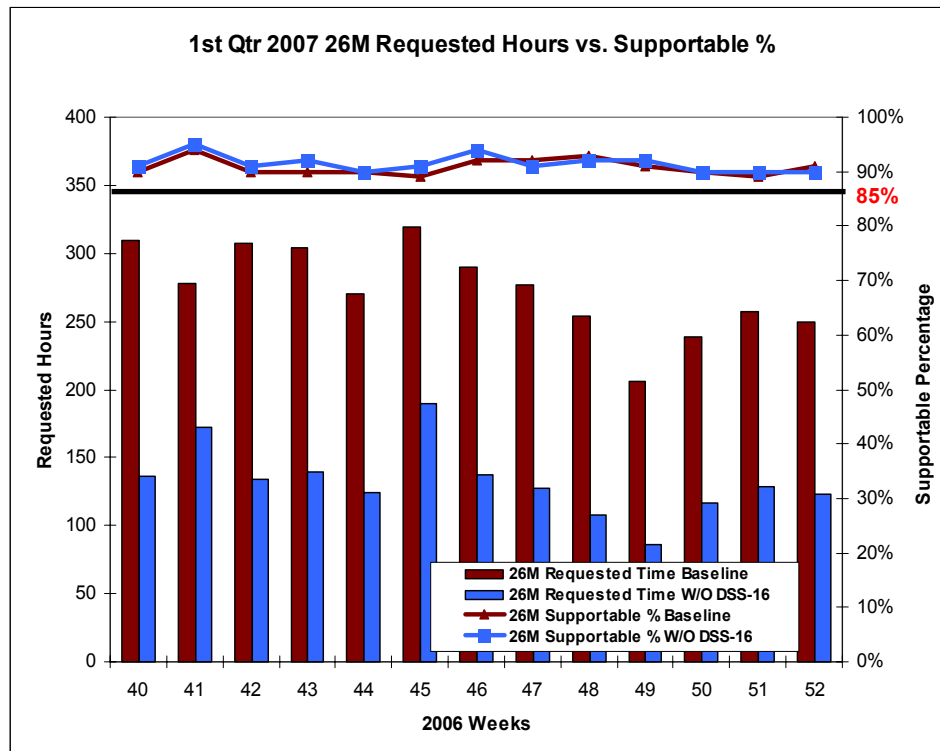


Figure 24: DSN Major Events and downtimes for 2005

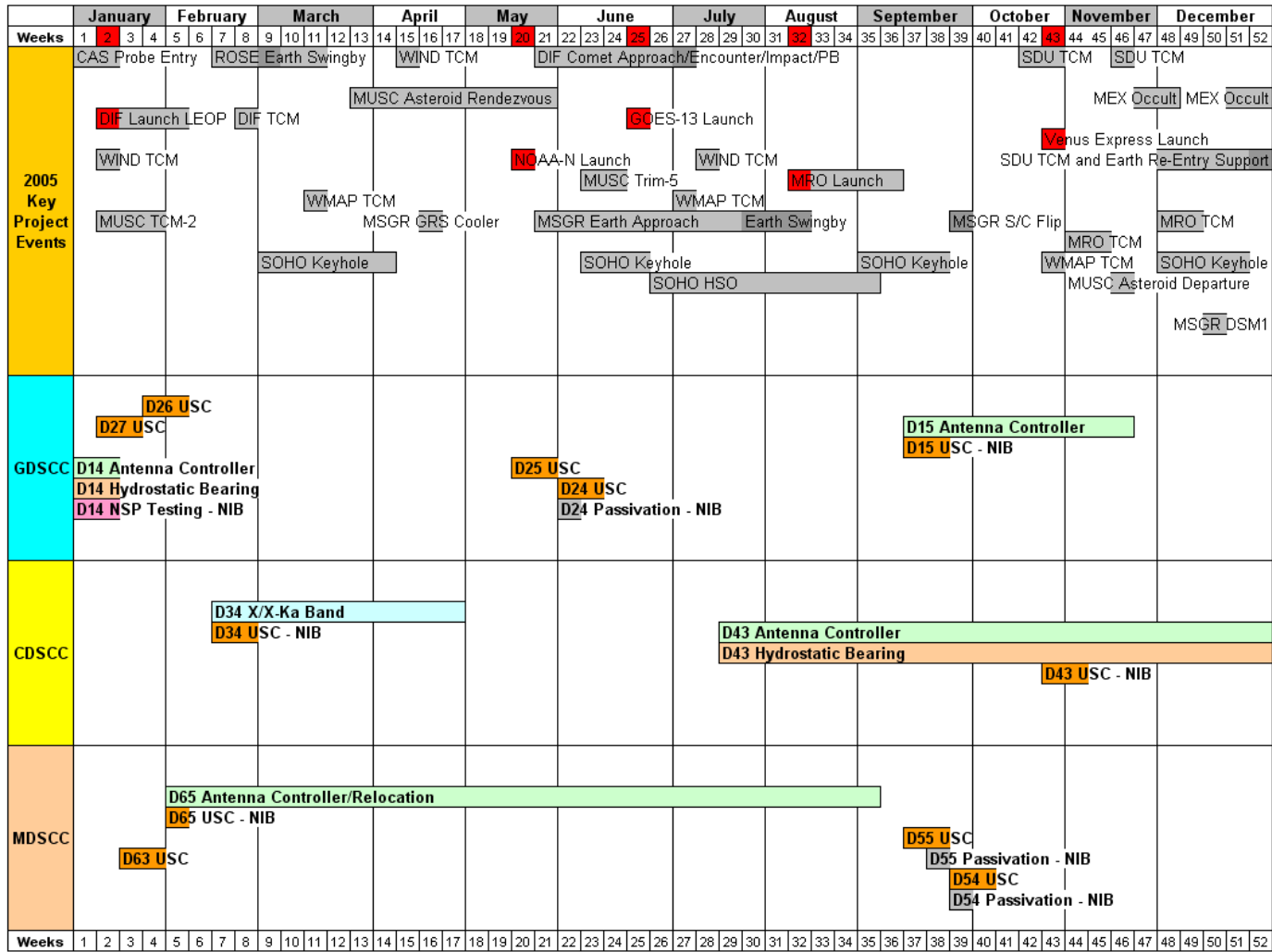


Figure 25: DSN Major Events and downtimes for 2006

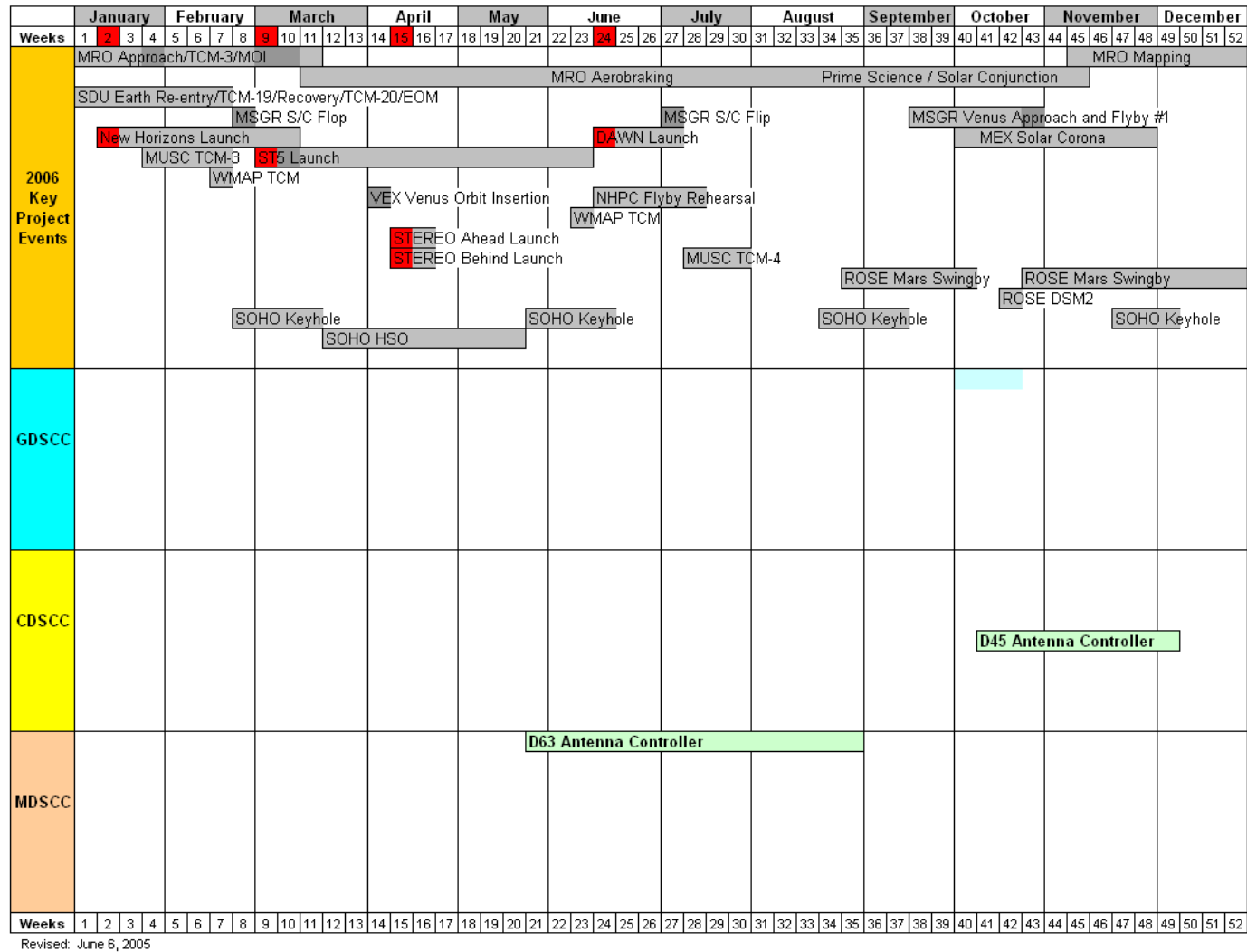
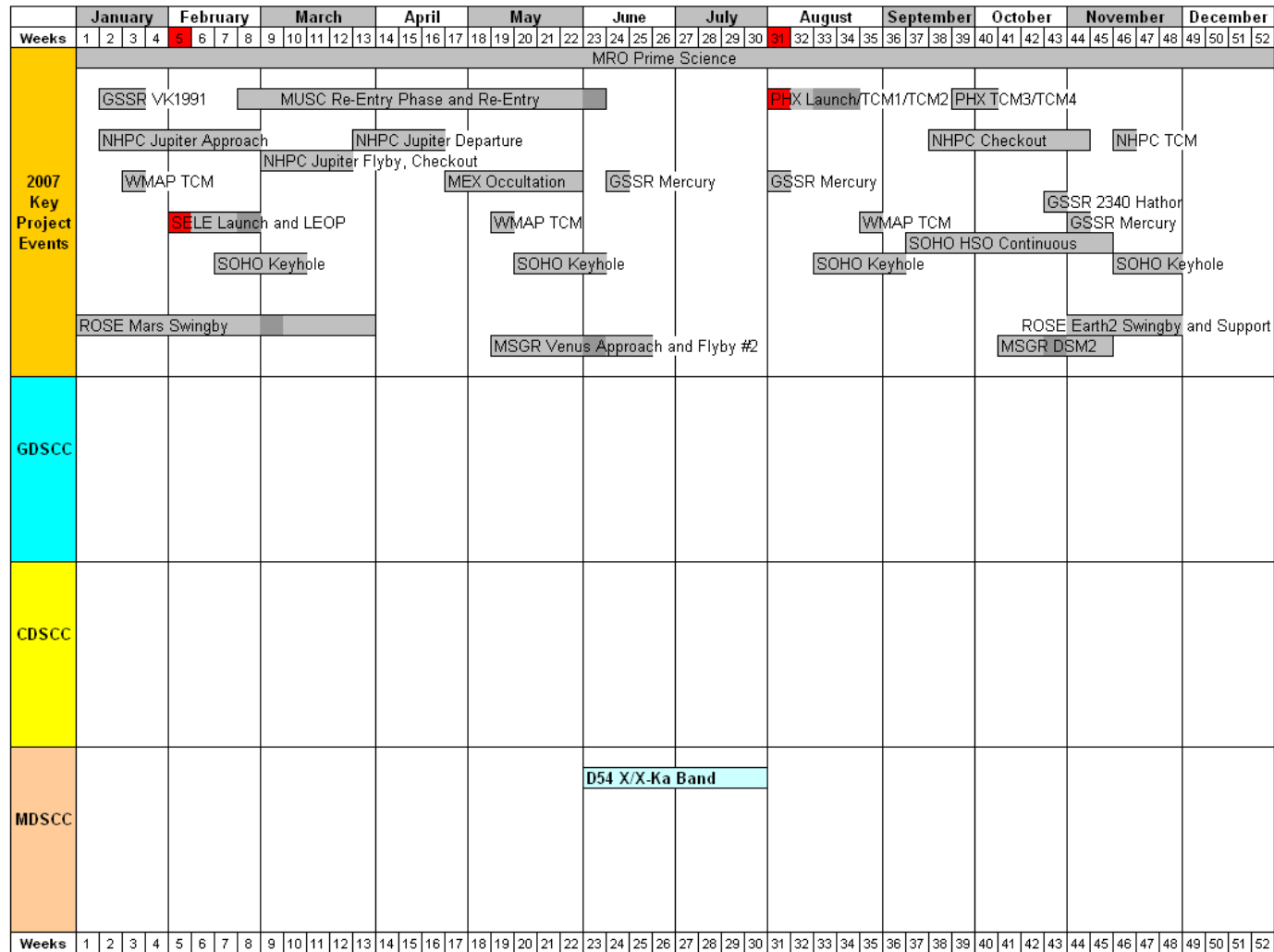


Figure 26: DSN Major Events and downtimes for 2007



Revised: June 6, 2005